ACADEMIC CURRICULA

UNDERGRADUATE DEGREE PROGRAMME

(Regulations 2022)

Bachelor Of Science

B.S. Chemistry
(Four years)

B.S. (Hons.) Chemistry
(Four years)

Learning Outcomes Based Curriculum Framework (LOCF)

Academic Year

2022 - 2023

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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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.S. Chemistry

7. Programme Structure (Total Credits:164)

1. Professional Core Courses (C) (24 Courses)

Course Code	Course Title	Hours/ Week			
		L	T	P	C
UPY22101J	Physics-I	3	0	2	4
UCY22101T	General Chemistry-I	3	0	0	3
UMA22101T	Mathematics-I	3	1	0	4
UBT22102J	Biology – I	3	0	2	4
UPY22201J	Physics-II	3	0	2	4
UCY22201J	General Chemistry-II	3	0	4	5
UMA22201T	Mathematics-II	3	1	0	4
UBT22202J	Biology – II	3	0	2	4
UCY22301J	Solution chemistry, Phase equilibria and Surface chemistry	4	0	4	6
UCY22302T	Basic concepts in organic chemistry	4	0	0	4
UCY22303T	Atomic Structure, Periodicity and Chemical Bonding	4	0	0	4
UCY22401J	Organic reaction mechanisms and Functional groups	4	0	4	6
UCY22402T	Main group and nuclear chemistry	4	0	0	4
UCY22403T	Quantum Chemistry and Group Theory	4	0	0	4
UCY22501J	Coordination chemistry	4	0	4	6
UCY22502T	Functional groups, heterocycles, polyaromatics and pericyclic reactions	4	0	0	4
UCY22503T	Molecular Spectroscopy and Photochemistry	4	0	0	4
UCY22601J	Analytical chemistry	4	0	4	6
UCY22602T	Organometallic and bioinorganic chemistry	4	0	0	4
UCY22603T	Organic name reactions and reagents	4	0	0	4
UCY22701T	Electrochemistry and Chemical dynamics	4	0	0	4
UCY22702T	Analysis of organic molecules	4	0	0	4
UCY22703T	Advanced Transition Metal Chemistry and Inorganic Spectroscopy	4	0	0	4
UCY22704T	Classical and Statistical Thermodynamics	4	0	0	4
Total Learning Credits					**104**

2. Discipline Specific Elective Courses (D) (4 Courses)

Course Code	Course Title	Hours/ Week			
		L	T	P	C
UCY22D01T	Introduction to nanochemistry and applications	3	0	0	3
UCY22D02T	Energy and fuel cells				
UCY22D03T	Solid state chemistry and its applications	3	0	0	3
UCY22D04T	Industrial chemistry				
UCY22D05T	Green chemistry	3	0	0	3
UCY22D06T	Introduction to computational Chemistry				
UCY22D07T	Chemistry of natural products	3	0	0	3
UCY22D08T	Biopolymers and biocomposites				
Total Learning Credits					12

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

Course Code	Course Title	Hours/ Week			
		L	T	P	C
ULT22G01J	Tamil-I	2	0	2	3
ULH22G01J	Hindi-I				
ULF22G01J	French-I				
ULT22G02J	Tamil-II	2	0	2	3
ULH22G02J	Hindi-II				
ULF22G02J	French-II				
UPY22G01T	LASER Physics	3	0	0	3
UMA22G01T	Foundations of Statistics				
UBT22G01T	Algal Cultivation				
Total Learning Credits					**09**

4. Skill Enhancement Courses(S) (3 Courses)

Course Code	Course Title	Hours/ Week			
		L	T	P	C
UCY22S01T	Materials Chemistry	2	0	0	2
UCY22S02T	Industrial Skills	2	0	0	2
UCY22S03T	Seminar	0	2	0	2
Total Learning Credits					**6**

5. Ability Enhancement Courses (AE) (3 Courses)

Course Code	Course Title	Hours/ Week			
		L	T	P	C
ULE22AE1T	English	4	0	0	4
UES22AE1T	Environmental Studies	3	0	0	3
UCY22AE1T	Research Methodolgy	3	1	0	4
Total Learning Credits					**11**

6. Life Skill Courses (Jeevan Kaushal) (JK) (3 courses)

Course Code	Course Title	Hours/ Week			
		L	T	P	C
UJK22201L	Communication Skills	0	0	4	2
UJK22301T	Universal Human Values	2	0	0	2
UJK22401T	Professional Skills	2	0	0	2
Total Learning Credits					**6**

7. Extension activity /(Community Outreach (EA) (2 Course)

Course Code	Course Title	Hours/ Week			
		L	T	P	C
UMI22S01L	My India Project	0	0	0	1
UNS22201L	NSS	0	0	0	0
UNC22201L	NCC				
UNO22201L	NSO				
UYG22201L	YOGA				
Total Learning Credits					**01**

8. Internship/ Project (2 courses)

Course Code	Course Title	Hours/ Week			
		L	T	P	C
UCY22P01L	Internship	0	0	0	3
UCY22P02L	MOOCs				
UCY22P03L	Major Project	0	0	24	12
Total Learning Credits					**15**

* Optional project

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 L	T	P	C
ULT22G01J	Tamil-I	2	0	2	3
ULH22G01J	Hindi-I				
ULF22G01J	French-I				
ULE22AE1T	English	4	0	0	4
UPY22101J	Physics-I	3	0	2	4
UCY22101T	General Chemistry-I	3	0	0	3
UMA22101T	Mathematics-I	3	1	0	4
UBT22102J	Biology-I	3	0	2	4
Total Learning Credits					22
Total Number of Hours					25

Semester – II

Code	Course Title	Hours/ Week L	T	P	C
ULT22G02J	Tamil-II	2	0	2	3
ULH22G02J	Hindi-II				
ULF22G02J	French-II				
UPY22201J	Physics-II	3	0	2	4
UCY22201J	General Chemistry-II	3	0	4	5
UMA22201T	Mathematics-II	3	1	0	4
UBT22202J	Biology-II	3	0	2	4
UJK22201L	Communication Skills	0	0	4	2
UNS22201L	NSS	0	0	0	0
UNC22201L	NCC				
UNO22201L	NSO				
UYG22201L	YOGA				
Total Learning Credits					22
Total number of hours /week					29

Semester – III

Course Code	Course Title	Hours/ Week L	T	P	C
UCY22301J	Solution chemistry, Phase equilibria and Surface chemistry	4	0	4	6
UCY22302T	Basic concepts in organic chemistry	4	0	0	4
UCY22303T	Atomic Structure, Periodicity and Chemical Bonding	4	0	0	4
UCY22S01T	Materials Chemistry	2	0	0	2
UES22AE1T	Environmental studies	3	0	0	3
UJK22301T	Universal Human Values	2	0	0	2
Total Learning Credits					21
Total Number of Hours					23

Semester - IV

Course Code	Course Title	Hours/ Week L	T	P	C
UCY22401J	Organic reaction mechanisms and Functional groups	4	0	4	6
UCY22402T	Main Group Elements and Nuclear Chemistry	4	0	0	4
UCY22403T	Quantum Chemistry and Group Theory	4	0	0	4
UCY22D01T	Introduction to nanochemistry and applications	3	0	0	3
UCY22D02T	Energy and fuel cells				
UCY22S02T	Industrial Skills	2	0	0	2
UJK22401T	Professional Skills	2	0	0	2
UMI22S01L	My India Project	0	0	0	1
Total Learning Credits					22
Total Number of Hours / Week					22

Semester - V

Course Code	Course Title	Hours/ Week L	T	P	C
UCY22501J	Coordination Chemistry	4	0	4	6
UCY22502T	Functional groups, heterocycles, polyaromatics and pericyclic reactions	4	0	0	4
UCY22503T	Molecular Spectroscopy and Photochemistry	4	0	0	4
UCY22D03T	Solid state chemistry and its applications	3	0	0	3
UCY22D04T	Industrial chemistry				
UCY22D05T	Green chemistry	3	0	0	3
UCY22D06T	Introduction to computational Chemistry				
Total Learning Credits					20
Total Number of Hours					22

Semester - VI

Course Code	Course Title	Hours/ Week L	T	P	C
UCY22601J	Analytical chemistry	4	0	4	6
UCY22602T	Organometallic and Bioinorganic chemistry	4	0	0	4
UCY22603T	Organic name reactions and reagents	4	0	0	4
UCY22D07T	Chemistry of natural products	3	0	0	3
UCY22D08T	Biopolymers and biocomposites				
UPY22G01T	LASER Physics	3	0	0	3
UMA22G01T	Foundations of Statistics				
UBT22G01T	Algal Cultivation				
Total Learning Credits					20
Total Number of Hours					25

Semester – VII					
Course Code	Course Title	Hours/ Week			C
		L	T	P	
UCY22701T	Electrochemistry and Chemical dynamics	4	0	0	4
UCY22702T	Analysis of organic molecules	4	0	0	4
UCY22703T	Advanced Transition Metal Chemistry and Inorganic Spectroscopy	4	0	0	4
UCY22704T	Classical and Statistical Thermodynamics	4	0	0	4
UCY22S03T	Seminar	0	2	0	2
UCY22P01L	Internship	0	0	0	3
UCY22P02L	MOOC				
UCY22AE1T	Research Methodolgy	3	1	0	4
Total Learning Credits					25
Total Number of Hours					22

Semester - VIII					
Course Code	Course Title	Hours/ Week			C
		L	T	P	
UCY22P03L	Major Project	0	0	24	12
Total Learning Credits					12
Total Number of Hours					24

Total number of credits: 164

9. Program Articulation Matrix

Course Code	Course Name	Programme Learning Outcomes														
		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
ULT22G01J	Tamil-I	H	H	H	H	H	-	-	-	-	-	-	-	-	-	-
ULH22G01J	Hindi-I	H	H	H	H	H	-	-	-	-	-	-	-	-	-	-
ULF22G01J	French-I	H	H	H	H	H	-	-	-	-	-	-	-	-	-	-
ULE22AE1T	English	H	-	H	-	-	-	-	-	-	-	-	-	-	-	H
UPY22101J	Physics-I	H	-	H	-	-	-	-	-	-	-	-	-	-	-	H
UCY22101T	General Chemistry-I	H	H	-	-	-	-	H	H	-	-	-	-	-	-	H
UMA22101T	Mathematics-I	H	H	H	H	H	-	-	-	-	-	-	-	-	-	H
UBT22102J	Biology – I	H	-	-	-	-	-	-	-	-	-	-	-	-	-	H
ULT22G02J	Tamil-II	H	H	H	H	H	-	-	-	-	-	-	-	-	-	-
ULH22G02J	Hindi-II	H	H	H	H	H	-	-	-	-	-	-	-	-	-	-
ULF22G02J	French-II	H	H	H	H	H	-	-	-	-	-	-	-	-	-	-
UPY22201J	Physics-II	H	-	H	H	-	-	H	-	-	-	-	-	-	-	-
UCY22201J	General Chemistry-II	H	M	M	H	-	-	L	-	-	-	-	-	-	-	H
UMA22201T	Mathematics-II	H	H	M	H	-	-	-	-	-	-	-	-	-	-	H
UBT22202J	Biology-II	H	-	-	H	-	-	H	-	-	-	-	-	-	-	H
UJK22201L	Communication Skills	H	H	M	L	H	-	L	-	-	-	-	-	-	-	H
UNS22201L	NSS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UNC22201L	NCC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UNO22201L	NSO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UYG22201L	YOGA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UCY22301J	Solution chemistry, Phase equilibria and Surface chemistry	M	M	L	M	L	-	-	-	-	-	-	-	-	-	-
UCY22302T	Basic concepts in organic chemistry	M	L	L	L	M	-	L	-	L	-	-	-	-	-	-
UCY22303T	Atomic Structure, Periodicity and Chemical Bonding	H	H	H	L	M	L	H	L	H	H	H	L	M	M	L
UCY22S01T	Materials Chemistry	M	M	L	L	L	-	-	-	-	-	-	-	-	-	-
UCY22D06T	Introduction to computational Chemistry	-	-	-	-	-	M	M	-	-	-	-	L	-	-	-
UCY22D01T	Introduction to nanochemistry and applications	H	H	M	L	H	-	L	-	-	-	-	-	-	-	H
UES22AE1T	Environmental studies	M	H	L	L	L	-	-	-	-	-	-	-	-	-	-
UJK22301T	Universal Human Values	M	H	L	L	L	-	-	-	-	-	-	-	-	-	-
UCY22401J	Organic reaction mechanisms and Functional groups	H	M	-	L	L	-	L	-	-	-	-	-	-	-	L
UCY22402T	Main group and nuclear chemistry	M	-	M	-	M	-	L	-	L	-	-	-	-	-	L
UCY22403T	Quantum Chemistry and Group Theory	M	L	L	L	M	L	L	L	-	-	-	-	-	-	L
UCY22D02T	Energy and fuel cells	M	H	L	L	L	-	-	-	-	-	-	-	-	-	-
UCY22S02T	Industrial skills	H	M	L	M	M	-	-	-	-	-	-	-	-	-	L
UJK22401T	Professional Skills	M	H	M	H	M	-	-	-	-	-	-	-	-	-	-
UMI22S01L	My India Project	M	M	L	L	M	-	-	L	-	-	-	-	-	-	L
UCY22601J	Coordination chemistry	M	L	M	L	L	L	L	-	-	-	-	-	-	-	-
UCY22602T	Functional groups, heterocycles, polyaromatics and pericyclic reactions	H	M	H	M	L	M	M	M	M	L	L	L	L	L	L

UCY22603T	*Molecular Spectroscopy and Photochemistry*	-	*M*	-	*L*	*L*	-	*L*	-	*L*	-	-	-	-	-	-
UCY22D03T	*Solid state chemistry and its applications*	*H*	*M*	*L*	*L*	*L*	-	*L*	-	-	-	-	-	-	-	-
UCY22D07T	*Chemistry of natural products*	*M*	*M*	*M*	*L*	*L*	-	*L*	-	-	-	-	-	-	-	*L*
UCY22D04T	*Industrial chemistry*	*H*	*M*	-	*L*	-	-	*L*	-	-	-	-	-	-	-	*L*
UCY22D05T	*Green Chemistry*	*H*	*M*	-	*L*	*L*	-	*L*	-	-	-	-	-	-	-	-
UCY22AE1T	*Research Methodology*	*M*	*L*	*L*	-	*M*	*M*	-	*L*	-	-	-	-	-	-	-
UCY22601J	*Analytical chemistry*	*M*	*H*	*L*	*L*	*L*	-	-	-	-	-	-	-	-	-	-
UCY22602T	*Organometallic and bioinorganic chemistry*	*M*	*L*	*L*	*L*	-	*L*	-	-	-	-	-	-	-	-	-
UCY22603T	*Organic name reactions and reagents*	*H*	*M*	-	*M*	*L*	-	*L*	-	-	-	-	-	-	-	*L*
UCY22D08T	*Biopolymers and biocomposites*	*H*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-
UPY22G01T	*LASER Physics*	*H*	*H*	*H*	*M*	*H*	-	-	-	-	-	-	-	-	-	*H*
UMA22G01T	*Foundations of Statistics*	*M*	*L*	*L*	*M*	*M*	-	-	*L*	-	-	-	-	-	-	*L*
UBT22G01T	Algal Cultivation	*H*	-	-	*H*	*H*	-	-	-	-	-	-	-	-	-	-
UCY22P01L	*Internship*	*M*	*M*	*M*	*H*	*H*	*L*	*L*	-	-	-	-	-	-	-	*L*
UCY22P02L	*MOOC*	*M*	*L*	*L*	*M*	*M*	-	-	*L*	-	-	-	-	-	-	*L*
UCY22701T	*Electrochemistry and Chemical dynamics*	*H*	-	-	-	*H*	-	-	-	*M*	-	-	-	*H*	-	_
UCY22702T	*Analysis of organic molecules*	*M*	*M*	*M*	*M*	*L*	-	*L*	-	-	*L*	-	-	-	-	*L*
UCY22703T	*Advanced Transition Metal Chemistry and Inorganic Spectroscopy*	*H*	*H*	*H*	*M*	*H*	-	-	-	-	-	-	-	-	-	*H*
UCY22704T	*Classical and Statistical Thermodynamics*	*H*	*H*	*H*	*M*	*H*	-	-	-	-	-	-	-	-	-	*H*
UCY22S03T	*Seminar*	*H*	*H*	-	-	*H*	-	*H*	-	*M*	-	-	*M*	-	-	-
UCY22P03L	*Major Project*	*H*	-	-	-	*H*	-	-	-	*M*	-	-	-	*H*	-	-
UCY22G01T	*Material Science and Nanotechnology*	*M*	*L*	*L*	*M*	*M*	-	-	*L*	-	-	-	-	-	-	*L*

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

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

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

Semester	Core Courses (C)	Discipline Electives Courses (D)	Generic Electives Courses (G)	Skill Enhancement Courses (S)	Ability Enhancement Courses (AE)	Extension Activity (EA)	Jeevan Kaushal Courses (JK)	Internship/ Project/ Community Outreach (P)	Total Credits
Sem I	**Foundation courses** Physics-I (4) General Chemistry-I (3) Mathematics-I (4) Biology – I (4)		GE -1 (3)		AE – 1 (4)				22
Sem II	Physics-II (4) General Chemistry-II (5) Mathematics-II (4) Biology – II (4)		GE – 2(3)			EA-1 (0)	JK-1(2)		22
Sem III	**Core courses** CC–3 (6) CC-4 (4) CC-5 (4)			S – 1 (2)	AE – 2 (3)		JK-2(2)		21
Sem IV	CC–6 (6) CC-7 (4) CC-8 (4)	DSE – 1 (3)		S – 2 (2)		EA-2(1)	JK-3(2)		22
Sem V	CC–9 (6) CC-10 (4) CC-11 (4)	DSE – 2 (3) DSE – 3 (3)							20
Sem VI	CC–12 (6) CC-13 (4) CC-14 (4)	DSE – 4 (3)	GE -3(3)						20
Sem VII	CC-15 (4) CC-16 (4) CC-17 (4) CC-18 (4)			S – 3 (2)	AE – 3 (4)			P-2 (3)	25
Sem VIII								P-3 (12)	12
Total Credits	**104**	**12**	**09**	**6**	**11**	**01**	**6**	**15**	**164****

****For B.S. (Hons.) Chemistry total number of credits are 176**

B.S. (Hons.) Chemistry

1. Programme Structure

1. Professional Core Courses (C) (3 Courses)					
Course Code	Course Title	Hours/ Week			C
		L	T	P	
UCY22H01T	Advanced Inorganic Chemistry	3	1	0	4
UCY22H02T	Advanced Organic Chemistry	3	1	0	4
UCY22H03T	Advanced Physical Chemistry	3	1	0	4
Total Learning Credits					**12***

***Student can earn 12 credits from any three Professional Core Courses of their choice to get Honours in Chemistry**

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

2. Implementation Plan

Semester – VI					
Code	Course Title	Hours/ Week			C
		L	T	P	
UCY22H01T	Advanced Inorganic Chemistry	3	1	0	4
Total Learning Credits					4
Total number of hours /week					4

Semester –VII					
Code	Course Title	Hours/ Week			C
		L	T	P	
UCY22H02T	Advanced Organic Chemistry	3	1	0	4
UCY22H03T	Advanced Physical Chemistry	3	1	0	4
Total Learning Credits					8
Total number of hours /week					8

3. Program Articulation Matrix

Course Code	Course Name	Programme Learning Outcomes														
		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
UCY22H01T	Advanced Inorganic Chemistry	H	H	-	H	H	-	H	-	-	-	-	-	-	-	H
UCY22H02T	Advanced Organic Chemistry	H	H	-	H	H	-	H	-	-	-	-	-	-	H	-
UCY22H03T	Advanced Physical Chemistry	H	H	H	H	H	-	H	-	-	-	-	-	-	-	-

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

Syllabus for B.S. Chemistry

SEMESTER I

Course Code	ULT22G01J	Course Name	Tamil-I	Course Category	G	Generic Elective Course	L	T	P	C
							2	0	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)

		Bloom's Level
CLR-1 :	*To enable them to learn the nuances of modern poetry in Tamil*	
CLR-2 :	To explore new historicism through the works of art written in Tamil to enlighten the students to understand the changes in the modern society	
CLR-3 :	Inculcate ways of life, moralities and ethical factors as an essential part of learning Tamil literature	
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:*	Bloom's Level	1 Disciplinary Knowledge	2 Critical Thinking	3 Problem Solving	4 Analytical Reasoning	5 Research Skills	6 Team Work	7 Scientific Reasoning	8 Reflective Thinking	9 Self-Directed Learning	10 Multicultural Competence	11 Ethical Reasoning	12 Community Engagement	13 PSO - 1	14 PSO - 2	15 PSO - 3
CLO-1 :	*Extend and expand their savoir-faire through the acquisition of skills to cater the needs of the modern era.*	*4*	*H*	-	*M*	-	*H*	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Enable the students to appreciate their mother tongue and to Enhance their thinking capacity	*4*	*H*	-	*H*	-	*M*	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Make them learn the basic rules of Language and make them communicate better	*4*	*M*	*H*	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Develop strategies of comprehension of texts based on different culture and life styles	*4*	*M*	-	*H*	-	*M*	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Strengthen spoken and written skills of the student	*4*	-	*H*	-	*M*	*H*	-	-	-	-	-	-	-	-	-	-

அலகு – 1 – கவிதைகள்

தமிழ் இலக்கியப் போக்குகள் – தமிழ்க்கவிதை மரபு

கவிதைகள் - 1. பாரதியார் – கண்ணன் என் சேவகன், 2. பாரதிதாசன் – தமிழின் இனிமை, 3. அப்துல் ரகுமான் – அவதாரம்

1. து. நரசிம்மன் – மன்னித்துவிடு மகனே

அலகு – 2 – கவிதைகள்

நவீன கவிதை தோற்றம் – நவீன கவிதை வரலாறு.

கவிதைகள் 1. ராஜாசந்திரசேகர் – கைவிடப்பட்ட குழந்தை , 2. அனார் – மேலும் சில இரத்தக் குறிப்புகள், 3. சுகிர்தராணி – அம்மா

4. நா.முத்துக்குமார் – தூர்

அலகு – 3 – சிற்றிலக்கியம் & காப்பியம்

1. கலிங்கத்துப்பரணி – பொருதடக்கைவாள் எங்கே.... (பாடல் – 484)
2. அழகர் கிள்ளை விடு தூது – இதமாய் மனிதருடனே.... (கண்ணி – 45)
3. நந்திக்கலம்பகம் – அம்பொன்று வில்லொடிதல்.... (பாடல் – 77)
4. குற்றாலக் குறவஞ்சி – ஓடக் காண்பது... (பாடல் – 9)
5. மணிமேகலை – உலக அறவி புக்ககாதை – "மாசு இல் வால்ஒளி! – இந்நாள் போலும் இளங்கொடி கெடுத்தனை" (28 அடிகள்)

அலகு – 4 – தமிழ் இலக்கிய வரலாறு மற்றும் உரைநடை

1. சிற்றிலக்கியம் – தோற்றமும் வளர்ச்சியும்
2. புதுக்கவிதை – தோற்றமும் வளர்ச்சியும்
3. சிறுகதை – தோற்றமும் வளர்ச்சியும்
4. புதினம் – தோற்றமும் வளர்ச்சியும்
5. அச்சு ஊடகம் – தோற்றமும் வளர்ச்சியும்

உரைநடை

6. உ.வே. சாமிநாதையர் – சிவதருமோத்திரச் சுவடி பெற்ற வரலாறு.
7. தஞ்சாவூர்க் கவிராயர் – கூஜாவின் கோபம்.

அலகு – 5 – மொழிப்பயிற்சி

1. அகரவரிசைப்படுத்துதல்
2. கலைச்சொல்லாக்கம்
3. மரபுத்தொடர்
4. பழமொழி
5. தமிழில் சொல் வகைகள் – பெயர்ச்சொற்கள், வினைச்சொற்கள், பெயரடை, வினையடை...

Learning Resources

1. குறிஞ்சித்தேன், தொகுப்பும் பதிப்பும் - தமிழ்த்துறை ஆசிரியர்கள், எஸ்.ஆர்.எம். அறிவியல் மற்றும் தொழில்நுட்பக் கல்விநிறுவனம், காட்டாங்குளத்தூர், 603203, 2020
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/

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	10%	10%	10%	10%	10%	10%	20%	10%	20%	-
Level 2	Understand	10%	10%	10%	10%	10%	10%	20%	10%	20%	-
Level 3	Apply	20%	20%	20%	20%	20%	20%	40%	20%	40%	-
Level 4	Analyze	10%	10%	10%	10%	10%	10%	20%	10%	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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. R..Srinivasan Associate Professor, Department of Tamil, Presidency College, Chennai,	*1. B.Jaiganesh, Assistant Professor & Head, FSH, SRMIST*
		2. T.R.Hebzibah Beulah Suganthi, Assistant Professor, FSH, SRMIST
		3.S.Saraswathy, Assistant Professor, FSH, SRMIST

Course Code	ULH22G01J	Course Name	HINDI-I	Course Category	G	Generic Elective Course	L	T	P	C
							2	0	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)

		Blooms Levels
CLR-1 :	*To be able to converse well in the Hindi Language*	
CLR-2 :	*To read and write and clarity*	
CLR-3 :	*To be willing listeners and translators –where need be*	
CLR-4 :	*To acquire the values/thought contents of the writers and practice in it in life.*	
CLR-5 :	*To find motivation through the various forms of literature and learn to overcome any challenges of life.*	
CLR-6 :	*To discover the importance of the language in making education as a means of growth in life and not mere literacy.*	

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Blooms Levels	1 Disciplinary Knowledge	2 Critical Thinking	3 Problem Solving	4 Analytical Reasoning	5 Research Skills	6 Team Work	7 Scientific Reasoning	8 Reflective Thinking	9 Self-Directed Learning	10 Multicultural Competence	11 Ethical Reasoning	12 Community Engagement	13 PSO -1	14 PSO -2	15 PSO-3
CLO-1 :	*To appreciate the Hindi language in its various forms.*	*4*	*H*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*To understand the philosophy of life and living through stories.*	*4*	-	*H*	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*To help the students learn and develop the fundamentals of life, through One-Act plays.*	*4*	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*To share the richness of thought and content presented in the Hindi language, into other languages so that the readers would stand to gain.*	*4*	*H*	-	*H*	*H*	*H*	-	-	-	-	-	*H*	-	-	-	-
CLO-5 :	*To guide the students in the learning of the technical aspect of the Hindi language, this would help them in the field of administration.*	*4*	-	*H*	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	*To encourage the students to communicate with the public, on a large scale with the medium of Main stream and Documentary films.*	*4*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

UNIT – 1
1. Vo Tera Ghar ye Mera Ghar – MALTI JOSHI
2. Mithaivala – SHRI BHAGAVATHY PRASAD VAJPEYI
3. Bachendri Pal – JEEVANI
4. Nadi aur Jeevan – DR. VIVEKI RAI
5. Pachees chauka Ded Sau – OMPRAKASH VALMIKI

UNIT – 2

1. Raat ke rahi – Sri Brajbusan
2. Akhbari vigyapan – Sri Cheerenjit

UNIT – 3
1. PATRKARITA
   a. Arth
   b. Paribhasha
   c. Swarup
   d. Prakar evam Daitava

UNIT – 4
1. FILM SAMIKSHA
a. 2 MAINSTREAM MOVIES
b. 2 CLASSIC OR DOCUMENTARY

UNIT – 5
1. TECHNICAL TERMINOLOGY

Learning Resources	***The Prescribe Text Book Compiled and Edited by Department of Hindi*** *www.gadyakosh.com* *www.shabdkosh.com*

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	10%	10%	10%	10%	10%	10%	20%	10%	20%	-
Level 2	Understand	10%	10%	10%	10%	10%	10%	20%	10%	20%	-
Level 3	Apply	20%	20%	20%	20%	20%	20%	40%	20%	40%	-
Level 4	Analyze	10%	10%	10%	10%	10%	10%	20%	10%	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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. 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

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Course Code	ULF22G01J	Course Name	French-I	Course Category	G	Generic Elective Course	L	T	P	C
							2	0	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 :	*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
CLR-6 :	Express their sentiments, emotions and opinions, reacting to information, situations

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Blooms Levels	1 Disciplinary Knowledge	2 Critical Thinking	3 Problem Solving	4 Analytical Reasoning	5 Research Skills	6 Team Work	7 Scientific Reasoning	8 Reflective Thinking	9 Self-Directed Learning	10 Multicultural Competence	11 Ethical Reasoning	12 Community Engagement	13 PSO -1	14 PSO -2	15 PSO-3
CLO-1 :	*To acquire knowledge about French language*	*4*	*H*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*To strengthen the knowledge on concept, culture, civilization and translation of French*	*4*	-	*H*	-	*H*	-	*H*	-	-	-	-	*M*	-	-	-	-
CLO-3 :	*To develop content using the features in French language*	*4*	*H*	-	-	*H*	-	*H*	-	-	-	-	*M*	-	-	-	-
CLO-4 :	*To interpret the French language into other language*	*4*	*H*	-	*H*	*H*	*H*	-	-	-	-	-	*H*	-	-	-	-
CLO-5 :	*To improve the communication, intercultural elements in French language*	*4*	-	*H*	-	*H*	-	-	-	-	-	-	*H*	-	-	-	-
CLO-6 :	*To acquire knowledge about French language*	*4*	*H*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-

Unité-I

Bonjour, ça va ? - Les pays et les nationalités - Les animaux domestiques- Les jours de la semaine les mois de l'année - Les nombres de 0 à 69 - La famille (1) - L'accent tonique - Les articles un/une et le/les - Bonjour, - Salut ! Je m'appelle Agnès -Mots et expressions – Entrer en contact- Se présenter.

Unité-II

Salut ! Je m'appelle Agnès Les pronoms personnels sujets - Les verbes être et avoir- Les articles définis et indéfinis - La formation du féminine (1) - La formation du pluriel (1) - Les adjectives possessifs - Entrer en contact : salut, demander et dire comment ça va - Se présenter et présenter quelqu'un - Demander et dire la date.

Unité-III

Qui est –ce ?- les professions - Quelques objets - la fiche d'identité - La liaison - L'élision - Intonation descendre/montante – Qui est-ce ? Dans mon sac – Mots et expressions – Demander et répondre poliment – Demander des informations personnelles.

Unité-IV

Dans mon sac, j'ai… la formation du féminin (3) - la phrase interrogative - *qu'est – ce que.. ?/Qu'est – ce que C'est/Qui est – ce ?- la phrase négative - C'est/il est (1) - Les verbes du premier group* - Les verbes *aller et venir* -Demander et répondre poliment - Demander des informations personnelles

Unité-V

Il est comment ?-L'aspect physique - Le caractère - Les prépositions de lieu (1) -Les nombre à partir de 70 - les sons [ə]/[e]/[ɛ] – Allo ? La formation du féminin(3) - Les articles contractés - Les pronoms personnels tonique - Il y a - Les adverbes interrogatifs - Les nombres - Les prépositions de lieu - Les verbes du deuxième group - Le verbe faire - Décrire l'aspect physique et le caractère - Parler au téléphone

Learning Resources	
	Theory:
	1. "**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.

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	10%	10%	10%	10%	10%	10%	20%	10%	20%	-
Level 2	Understand	10%	10%	10%	10%	10%	10%	20%	10%	20%	-
Level 3	Apply	20%	20%	20%	20%	20%	20%	40%	20%	40%	-
Level 4	Analyze	10%	10%	10%	10%	10%	10%	20%	10%	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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. C.Thirumurugan Associate Professor, Department of French, Pondicherry University	*1. Kumaravel K. Assistant Professor & Head, SRMIST*
		2. Ponrajadurai M Assistant Professor, SRMIST

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Course Code	ULE22AE1T	Course Name	English	Course Category	A	Ability Enhancement Course	L	T	P	C
							4	0	0	4

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*Extend and expand the integrity in an individual which shall never allow him/her to compromise upon a noble way of living*
CLR-2:	Enable the students to overcome the fear of speaking a foreign language and enable them to think through a foreign language
CLR-3:	Make them communicate an unbiassed way of thinking in a better manner
CLR-4:	Develop strategies of comprehension of texts based on different culture and life styles
CLR-5:	Help them express their sentiments, emotions and opinions, and reactions to information and situations in a civilized, cultured and humane manner.

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning	Program Learning Outcomes (PLO)														
		Bloom's Level	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
CLO-1:	*To acquire knowledge of becoming better beings through the tools of Language and Literature*	*4*	H	-	-	-	-	-	-	-	-	-	-	-	-	-	*H*
CLO-2:	*To acquire a strong knowledge on concept, culture, civilization through English Literature*	*4*	H	-	-	-	-	-	-	-	-	-	-	-	-	-	*H*
CLO-3:	*To develop own content and to be able to translate using the features in English Language*	*4*	H	-	-	-	-	-	-	-	-	-	-	-	-	-	*H*
CLO-4:	*To interpret the contents in the texts presented in English Language*	*4*	H	-	-	-	-	-	-	-	-	-	-	-	-	-	*H*
CLO-5:	*To present an improved and healthier communication and intercultural elements acquired through English Literature*	*4*	H	-	-	-	-	-	-	-	-	-	-	-	-	-	*H*

UNIT I
POETRY

1. PUNISHMENT IN KINDERGARTEN – KAMALA DAS
2. PHALLUS I CUT – KALKI
3. OBITUARY _ A. K. RAMANUJAM
4. APOLOGIES FOR LIVING ON – MEENA KANDASAMY

UNIT II

LETTERS BY MATHRABOOTHAM PUBLISHED IN THE HINDU
(LETTERS WITH REGIONAL RELEVANCE AND NATIONAL SIGNIFICANCE)

1. ENJOY WITHIN LIMITS, SAYS MR MATHRUBOOTHAM
2. NOBEL? WHAT NOBEL, ASKS MR MATHRUBOOTHAM
3. MR MATHRUBOOTHAM IS FULLY SUPPORTING ALL NEW TECHNOLOGIES
4. PIZZA MAAVU : WELCOME TO MR MATHRUBOOTHAM FOOD RECIPIE WEBSITE

UNIT III

1. STORY THROUGH IMAGES
2. AUTOBIOGRAPHY OF CONCRETE OBJECTS
3. CAPTION WRITING
4. PUBLIC SPEAKING

UNIT IV

LISTENING AND READING

1. MONOLOGUES
2. CONVERSATIONS
3. LOUD READING
4. READING COMPREHENSION

UNIT V

LANGUAGE COMPONENTS

1. PARTS OF SPEECH
2. TENSES
3. ARTICLES
4. PREPOSITION
5. ERRORS IN SENTENCES

Learning Resources	***Theory:*** 1. Horizon- English Text Book – Compiled and Edited by the Faculty of English Department, FSH, SRMIST, 2020 ***English Gramar in Use by Raymond Murphy***

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	20%	-	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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
		1. Dr. Shanthichitra, Associate Professor, & Head, Department of English, FSH, SRMIST
		2. Dr K B Geetha, Assistant Professor, Department of English, FSH, SRMIST

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Course Code	UPY22101J	Course Name	Physics-I	Course Category	C	Professional Core Course	L	T	P	C
							3	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
CLR-1:	Understand, explain and derive the various mechanics problems	Bloom's Level
CLR-2:	Emphasize the basic mathematical formulation of mechanics problems	
CLR-3:	Apply the fundamental concepts of mechanics to solve mechanics problems	
CLR-4:	Develop problem solving and critical thinking	
CLR-5:	Develop basic understanding of waves and oscillations	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning	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	ICT Skills	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1:	Understand vector to the language that is useful in physics	4	H	-	H	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2:	Understand analogous concepts for rotational motion	4	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-3:	Learn the laws of mechanics under the force field	4	H	-	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-4:	Basic knowledge on simple harmonic oscillator under damping and driving conditions	4	H	-	H	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5:	Gain knowledge on various waveforms and perform mechanics related experiments	4	H	-	H	-	-	-	-	-	-	-	-	-	H	-	-

Unit-1: Scalar field and vector field, Vector triple product and Reciprocal sets of vectors, Area of a triangle using vector cross product, Work done in moving object along a vector
Determination a unit vector perpendicular to a plane, Equation for a plane using vector rules, Determination the velocity and acceleration of a particle from its parametric equations
Determination the component of velocity and acceleration in a direction of a particle from its parametric equations, Velocity and acceleration of a particle with a given position vector r, Physics of Gradient in a vector field, Laplacian operator and Grad of a scalar field, Understand the rotational properties from the Curl in a vector field, Reference frames, Inertial frame, Newton's Law of Motion, Galilean Transformation, Transformation equations for a Frame of Reference, Conservation of linear momentum, Conservation of linear angular momentum, Work, Kinetic energy, Concept of power and energy, Problem solving

Experiment no. 1: Newton's 2nd law-Demonstration track with measure Dynamics
Experiment no. 2: Determination of moment of inertia and acceleration due to gravity using Bifilar pendulum

Unit-2: Conservative Force Field, Potential Energy, Impulse, Torque, Conservation of Energy, Non-conservative force, Center of Mass, Center of mass frame of reference, Motion of the Centre of mass, Collision, elastic collision, inelastic collision, Moment of Inertia (MI), Physical significance of MI, Moment of Inertia of a uniform thin rod, Circular lamina, Rectangular lamina, Solid Sphere, Solid Cylinder, and hollow cylinder, Product of moment of Inertia, Principal moments, Problem solving

Experiment no. 3: Determination of rigidity modulus of the suspension wire - Torsional pendulum
Experiment no. 4: Determination of acceleration due to gravity-Compound bar pendulum

Unit-3: : Uniform force field, Uniformly accelerated motion, Weight and acceleration due to gravity, Freely falling bodies, Projectiles, Motion of a projectile in Uniform gravitational field, Potential energy in a uniform force field, Motion in a resisting medium, Friction, Central forces, Properties of central force fields, Equation of Motion for a particle in a central field, Determination of the orbit from central force, Kepler's laws of planetary motion, Law of gravitation from Kepler's laws, Motion in an inverse square field, Problem solving

Experiment no. 5: Determination of spring constant-expansion of a helical spring
Experiment no.6: Determination of Static friction, sliding friction and rolling friction

Unit-4: Oscillations in physical systems, Simple harmonic motion, The force law of simple harmonic motion, Energy in simple harmonic motion, Angular simple Harmonic oscillator, Simple pendulums,
Physical pendulum, Vertical and angular simple harmonic motion, Vibrations of molecules, Vibrations of molecules, Damped simple harmonic motion, Energy in damped oscillations, Driven oscillations, Resonance and its consequences, Power dissipation, Problem solving

Experiment no 7: Determination of Moment of inertia and angular acceleration with precision pivot bearing

Experiment no.8: Measurement of Free fall-Dynamics method
Unit-5: Transverse and Longitudinal waves, Sinusoidal waves, Wave speed on a stretched string, Energy and power of a wave traveling along a string, Wave equation, Principle of superposition, Interference of waves, Standing waves and resonance, Sound waves, Speed of sound waves, Formal derivation, Traveling sound waves, Intensity and sound level, Sources of musical sound: Standing waves with two open ends and one open end pipes, Beats, Doppler effect, Shock waves, Ultrasonics: Production, properties and applications, Problem solving **Experiment no. 9**: Determination of Young's Modulus Uniform Bending **Experiment no. 10**: Determination of frequency of AC mains using Sonometer.

Learning Resources	1. An Introduction to Mechanics David Kleppner, Robert Kolenkow McGraw Hill Education India, 2007 2. Halliday, Resnick and Walker (2015), "Fundamentals of Physics" – 10th ed. Wiley, New York	3. University Physics with Modern Physics, (12th Ed., H. D. Young and R. A. Freedman, 2011) 4. Mechanics Berkeley Physics course, v.1 Charles Kittel (Tata McGraw Hill, 2007) 5. Theory and Problems of Theoretical Mechanics (Schaum's Outline)1982, Murray R. Spiegel, McGraw Hill Education India

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	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Level 2	Understand	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Level 3	Apply	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Level 4	Analyze	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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
Dr. DK Aswal, NPL, dkaswal@nplindia.org	*Prof. V Subramanian, IIT Madras, manianvs@iitm.ac.in*	1.Dr. Debabrata Sarkar, SRMIST
Dr. M Sathish, CSIR-CECRI, msathish@cecri.re.in	*Prof. C Venkateshwaran, University of Madras, venkateshwaran@unom.ac.in*	2.Dr. K Shadak Alee, SRMIST

Course Code	UCY22101T	Course Name	General Chemistry-I	Course Category	C	Professional Core Course	L	T	P	C
							3	0	0	3

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 basic organic chemistry.	
CLR-2 :	acquire knowledge about hydrocarbon and their reactions.	
CLR-3 :	promote the importance of silicon and metals.	
CLR-4 :	understand the principles of gaseous state	
CLR-5 :	Acquire in-depth understanding about the colligative properties	

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
			Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	ICT Skills	Life Long Learning	PSO -1	PSO -2	PSO-3
CLO-1 :	understand the basic concepts of organic chemistry	4	H	-	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-2 :	gain knowledge about the organic reactions	4	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-3 :	understand about the importance of silicon and metals	4	H	-	-	-	M	-	-	-	-	-	-	-	-	-	-
CLO-4 :	apply the laws and the expressions related to the gaseous state	4	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	acquire knowledge about the colligative properties of solutions	4	-	H	-	-	-	-	H	-	-	-	-	-	-	-	-

UNIT- I: Introduction of Hybridization and Isomerism

Hybridization - sp, sp^2 and sp^3-Bond length- bond angle- dipole moment- inductive effect- mesomeric effect and hyperconjucation - Isomerism- geometrical and optical isomerism- optical activity- asymmetry- dissymmetry, elements of symmetry- R, S notations.

UNIT-II: Hydrocarbons

Methods of preparation of alkanes, properties - Reactions. Free radical mechanism of halogention of alkanes, Methods of preparation of alkenes - Stereochemistry of dehydrohalogenation (E1, E2, E1CB mechanism). Properties of alkenes -Electrophilic and nucleophilic addition mechanisms.

UNIT- III: General Principles of Metallurgy

Ore vs mineral, Principles of metallurgy, Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide. Types of metallurgy, Electrometallurgy - Extraction of Al, Hydrometallurgy with reference to cyanide process, Methods of purification of metals: Electrolytic refining, Vapour phase refining (van Arkel-de Boer process and Mond's process), Zone refining.

UNIT- IV: Gaseous State

Gaseous state - laws of gaseous state- gas constant R in different units - deviation from ideal behaviour- Van der waals equation for real gases - critical phenomenon - PV isotherm of real gases- critical temperature - critical volume. Molecular velocities - root mean square-average and most probable velocities. Maxwell distribution law collision number and mean free path - collision diameter.

UNIT-V: Colligative Properties of Dilute Solutions

Solution - dilute solutions - definition - Raoult's law for vapour pressure lowering (equation only) - Van't Hoff equation (no derivation) - Determination of molar mass from osmotic pressure measurement -Reverse osmosis. Boiling point elevation - Derivation of molal elevation constant (K_b) **- D**etermination of molar mass from boiling point elevation. Freezing point depression - Determination of molar mass from freezing point depression.

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	20%	-	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-

Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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.Prof. M. Arthanareeswari, SRMIST
	Dr. Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru Email: kanishka@jncasr.ac.in	2.Dr. T. Pushpa Malini, SRMIST

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Course Code	UMA22101T	Course Name	Mathematics-I	Course Category	C	Professional Core Course	L	T	P	C
							3	1	0	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)

		Bloom's Level	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	ICT Skills	Life Long Learning	PSO -1	PSO -2	PSO-3
CLR-1:	*Learn the concept of differentiation*																
CLR-2:	*Apply the concepts of radius of curvature, evolute, envelope in problems of Science and Engineering*																
CLR-3:	*Learn the concept of integration by means of various methods*																
CLR-4:	*Apply the concept of integration in area and volume*																
CLR-5:	*Application of Sequences and Series in all problems involving Science and Engineering*																
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																
CLO-1:	*Understand the concept of differentiation and its types*	*4*	*H*	*M*	*H*	*H*	*H*	-	-	-	-	-	-	*H*	-	-	-
CLO-2:	*Gain the knowledge of Radius, Centre, envelopre and Circle of of curvature and apply them in the problems involving Science and Engineering*	*4*	*H*	*H*	*M*	*H*	*H*	-	-	-	-	-	-	*H*	-	-	-
CLO-3:	*Understand the concept of different methods of solving integrals*	*4*	*H*	*H*	*H*	*H*	*M*	-	-	-	-	-	-	*H*	-	-	-
CLO-4:	*Associate the rule of integration in finding length and area of a curve*	*4*	*H*	*H*	*M*	*H*	*H*	-	-	-	-	-	-	*M*	-	-	-
CLO-5:	*Gain the knowledge of convergence and divergence of series using different test and apply sequences and Series*	*4*	*M*	*H*	*M*	*M*	*H*	-	-	-	-	-	-	*M*	-	-	-

Unit-1: Introduction- Derivatives of simple functions- Successive differentiation- Problems on algebraic and trigonometric functions.

Unit-2: Curvature and Radius of Curvature, circle of curvature, Evolutes, Envelope.

Unit-3: Introduction to integration- Methods of integration- Substitution method- Integration by parts- Bernoulli's Formula- Definite Integrals- Properties **Unit-3:** and applications of definite integrals.

Unit-4: Arc length, area, volume, surface area of revolution.

Unit-5: Introduction to sequences and series- Series of positive terms- Test of Convergence- Comparison test- Integral test- De Alembert's ratio test- Raabe's root test- Alternating series- Leibnitz's test- Absolute convergence- Conditional convergence.

Learning Resources

1. N. Piskunov, Differential and Integral Calculus Vol. 1-2, Mir Publishers, 1996.
2. P. R. Vittal, Allied Mathematics, 4th Edition Reprint, Margham Publications, Chennai, 2012.
3. S. Narayanan and T K Manicavachagom Pillay, Calculus, Vol.I, S. Viswanathan Printers and Publishers Pvt. Ltd., 2009.
4. S. Narayanan and T K Manicavachagom Pillay, Calculus Vol.II, S.Viswanathan Printers and Publishers Pvt. Ltd., 2010
5. T. M. Apostol, Calculus, Volumes 1 and 2 (2nd Edition), Wiley Eastern 1991.
6. J.E. Marsden, A.J. Tromba, A. Weinstein, Basic Multivariable Calculus, W.H.Freeman & Co Ltd; 3rd edition 2001

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (100% 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	20%	-	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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
Mr. Madhan Shanmugasundaram , Director, Infosys Technologies, Chennai madshan@gmail.com	*Prof. Y.V.S.S. Sanyasiraju, IIT Madras, sryedida@iitm.ac.in*	Dr.B.Vennila, SRMIST
	Prof. B. V. Rathish Kumar, IIT Kanpur, bvrk@iitk.ac.in	*Dr E. Sujatha, SRMIST*

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Course Code	UBT22102J	Course Name	Biology-I	Course Category	C	Professional Core Course	L	T	P	C
							3	0	2	4

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

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

		Bloom's Level
CLR-1 :	*present the importance of light in life processes*	
CLR-2 :	*understand the process of oxygen evolution and its reaction centres*	
CLR-3 :	*gain knowledge on the concepts on cells and its structures*	
CLR-4 :	*acquire knowledge on the various regulation process in animals*	
CLR-5 :	*have introduction on the various macromolecules and its structures*	

	Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Bloom's Level
CLO-1 :	*a perspective on the effect of light in life processes*		*4*
CLO-2 :	*provides an understanding on the oxygen production and the reaction centres*		*4*
CLO-3 :	*an insight into the structure of cell and microscopes is obtained*		*4*
CLO-4 :	*the regulatory system gives an understanding on the basic maintenance of the body*		*4*
CLO-5 :	*basic knowledge is gained about the macromolecules*		*4*

	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	ICT Skills	Life Long Learning	PSO -1	PSO -2	PSO-3
CLO-1 :	*H*	-	-	-	-	-	-	-	-	-	-	*H*	-	-	-
CLO-2 :	*H*	-	-	-	-	-	-	-	-	-	-	*H*	-	-	-
CLO-3 :	*H*	-	-	-	-	-	-	-	-	-	-	*H*	-	-	-
CLO-4 :	*H*	-	-	-	-	-	-	-	-	-	-	*H*	-	-	-
CLO-5 :	*H*	-	-	-	-	-	-	-	-	-	-	*H*	-	-	-

UNIT- I: **Nature of light**

Light and its importance in life process, effect of radiation on biological processes (plant and animals), pigments/receptors of light- chlorophylls, phyto-chromes rhodopsin, Photo Biological reactions,

Photoreception in animals, evolution of eye and visual processing

PRACTICALS :

1. **Moll's half leaf experiment**
2. **To test / survey for colour blindness using Ishihara charts**

UNIT- II: **Light and dark reactions**

Photolysis of water and oxygen evolution, O2 evolving complex, Oxygenic and An-oxygenic photosynthesis, reaction centres, Bacterial Photosynthesis

PRACTICALS:

1. **Demonstration of Hill's reaction**
2. Chemical separation of chloroplast pigments

UNIT- III: The Cell

The concept of cell, Prokaryotes and eukaryotes, **Ultrastructure of cells (Bacteria, plant & animal), Microscope and its functioning,**

PRACTICALS

1. Media preparation for cell growth
2. Preparation of slides for viewing live bacterial cells

UNIT –IV: Homeostasis

Ectothermic animals, Endothermic animals, Temperature regulation, control of blood glucose levels, Liver and its importance in maintaining homeostasis

UNIT - V: Introduction to Macromolecules

Carbohydrates, Lipids, Amino acids, Nucleic acids, Vitamins

PRACTICALS:

1. Qualitative analysis of carbohydrates
2. Qualitative analysis of amino acids

Learning Resources	1. **D.J. Taylor, N.P.O. Green, G.W.Stout. Biological Science, Cambridge Publications** 2. **Lisa A. Urry, Michael L. Cain, Steven Alexander Wasserman, Peter V. Minorsky, Rebecca B. Orr · Pearson. Campbell Biology.**

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (100% 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	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Level 2	Understand	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Level 3	Apply	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Level 4	Analyze	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-

Level 6	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 Higher Technical Institutions	**Internal Experts**
1.Dr. M. Sujatha, Associate Professor & HOD, Department of Biotechnology, Ethiraj College for Women, Chennai 2.Dr. SUMATHI, Associate Professor, SRMC, Porur, Chennai	**Dr. N. Prasanth Bhatt, SRMIST**

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SEMESTER II

Course Code	ULT22G02J	Course Name	Tamil-II	Course Category	G	Generic Elective Course	L	T	P	C
							2	0	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)

		Bloom's Level
CLR-1:	To generate in students a sensitivity to gender marginalization and Eco sensitivity.	
CLR-2:	An evolved consciousness in the minds to accommodate all is developed	
CLR-3:	The ability to accept all and to co- exist is initiated	
CLR-4:	To create community connectivity and interdependence is initiated	
CLR-5:	To give them all the historical insights	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Bloom's Level	1 Disciplinary Knowledge	2 Critical Thinking	3 Problem Solving	4 Analytical Reasoning	5 Research Skills	6 Team Work	7 Scientific Reasoning	8 Reflective Thinking	9 Self-Directed Learning	10 Multicultural Competence	11 Ethical Reasoning	12 Community Engagement	13 PSO - 1	14 PSO - 2	15 PSO - 3
CLO-1:	To acquire knowledge about Tamil Language	4	M	-	H	-	M	-	-	-	-	-	-	-	-	-	-
CLO-2:	To strengthen the knowledge on concept, culture, civilization and translation of Tamil	4	M	H	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-3:	To develop content using the features in Tamil language	4	H	-	M	-	H	-	-	-	-	-	-	-	-	-	-
CLO-4:	To use Tamil Language and Literature to enhance their creativity	4	M	H	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-5:	To improve communication and creative expression in Tamil language	4	M	-	-	H	H	-	-	-	-	-	-	-	-	-	-

அலகு – 1 – பதினெண் மேற்கணக்கு

எட்டுத்தொகை : தமிழில் காலந்தோறும் அகமரபு – தமிழர் புறமரபு

1. ஐங்குறுநூறு – அன்னாய் வாழி வேண்டு (பாடல் – 203)
2. குறுந்தொகை – நிலந்தொட்டுப் புகார் (பாடல் – 130)
3. அகநானூறு – வந்து வினை முடித்தனன் வேந்தனும் பகைவர் (பாடல் – 44)
4. கலித்தொகை – நிரை திமில் களிறாக (நெய்தற்கலி பாடல் – 149)
5. புறநானூறு – சிறியகள் பெறினே (பாடல் – 235)

பத்துப்பாட்டு - சிறுபாணாற்றுப்படை (அடிகள் – 126 – 143)

அலகு – 2 - பதினெண் கீழ்க்கணக்கு :

களப்பிரர் காலம் – அறமும் வாழ்வியலும் .

1. திருக்குறள் – வினைத்திட்பம் (அதிகாரம் 67), உழவு (அதிகாரம் 104), 2. நாலடியார் – நல்லார் எனத்தான் (221), 3. திரிகடுகம் – கோலஞ்சி வாழும் குடியும் (33), 4. இனியவை நாற்பது (14), 5. களவழி நாற்பது – கவளங்கொள்யானை (14)

அலகு – 3 – பக்தி இலக்கியம்

பல்லவர் காலம் – பல்லவர் கால இலக்கியங்கள் – பக்தியும் தமிழும்.

1. சைவம் – பன்னிருதிருமுறைகள் - திருஞானசம்பந்தர் – வேயுறுதோளிபங்கன், திருநாவுக்கரசர் – மாசில் வீணையும் மாலை மதியமும், மாணிக்கவாசகர் – தந்தது உன் தன்னை கொண்டது என் தன்னை.
2. வைணவம் – நாலாயிரத் திவ்யப்பிரபந்தம் - பெரியாழ்வார் – கருங்கண் தோகை மயிற்பீலி அணிந்து, ஆண்டாள் – கருப்பூரம் நாறுமோ? கமலப்பூ நாறுமோ? ...., தொண்டரடிப்பொடி ஆழ்வார் – பச்சைமாமலை போல் மேனி
3. இஸ்லாமியம் - சீறாப்புராணம் - மானுக்குப் பிணை நின்ற படலம் – 5 பாடல்கள் (பாடல் எண்கள் : 61 – 65)
4. கிறித்துவம் - வேதக்கண் – ஆதி நந்தாவனப் பிரளயம் – ஏதேன் தோட்ட வர்ணனை (3 பாடல்கள்)

அலகு – 4 - தமிழ் இலக்கிய வரலாறு சங்க கால வரலாறு – சங்க கால மக்களின் வாழ்வியல் – முச்சங்கம் அறிமுகம் – முச்சங்க வரலாறு – செம்மொழி இலக்கியங்கள் 1. சங்க இலக்கியங்கள், 2. நீதி இலக்கியங்கள், 3. ஐம்பெருங்காப்பியங்கள், 4. பக்தி இலக்கியங்கள்
அலகு – 5 - சிறுகதையும் மொழிப்பயிற்சியும் தமிழ்ச் சிறுகதைப் போக்குகள் – தமிழ்ச் சிறுகதையும் தமிழ்ச்சமூக வாழ்வியலும் **சிறுகதைகள் – 1.** புதுமைப்பித்தன் – அகலிகை, 2. அகிலன் – ஒருவேளைச்சோறு, 3. ஆண்டாள் பிரியதர்ஷினி – மாத்திரை, 4. பாரததேவி – மாப்பிள்ளை விருந்து, 5. தவிப்பு – குன்றக்குடி சிங்காரவடிவேல் **மொழிப்பயிற்சி : 1.** செய்தி அறிக்கை எழுதுதல் , 2. விமர்சனம், 3. நேர்காணல், 4. பேச்சுக்கலை

Learning Resources	1. மௌவல், தொகுப்பும் பதிப்பும் - தமிழ்த்துறை ஆசிரியர்கள், தமிழ்த்துறை, எஸ்.ஆர்.எம். அறிவியல் மற்றும் தொழில்நுட்பக் கல்விநிறுவனம், காட்டாங்குளத்தூர், 603203, 2020. 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 (100% 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	10%	10%	10%	10%	10%	10%	20%	10%	20%	-
Level 2	Understand	10%	10%	10%	10%	10%	10%	20%	10%	20%	-
Level 3	Apply	20%	20%	20%	20%	20%	20%	40%	20%	40%	-
Level 4	Analyze	10%	10%	10%	10%	10%	10%	20%	10%	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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. R..Srinivasan, Associate Professor, Department of Tamil, Presidency College, Chennai.	*1. B.Jaiganesh, Assistant Professor & Head, FSH, SRMIST*
		2. T.R.Hebzibah Beulah Suganthi, Assistant Professor, FSH, SRMIST
		3.S.Saraswathy, Assistant Professor, FSH, SRMIST

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Course Code	ULH22G02J	Course Name	Hindi-II	Course Category	G	Generic Elective Course	L	T	P	C
							2	0	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)

		Bloom's Level	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	PSO -1	PSO -2	PSO-3
CLR-1:	To be able to converse well in the Hindi Language																
CLR-2:	To read and write and clarity																
CLR-3:	To be willing listeners and translators –where need be																
CLR-4:	To acquire the values/thought contents of the writers and practice in it in life.																
CLR-5:	To find motivation through the various forms of literature and learn to overcome any challenges of life.																
CLR-6:	To discover the importance of the language in making education as a means of growth in life and not mere literacy.																
CLO-1:	To acquire knowledge about Medieval and Modern Poetry.	4	H	H	H	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2:	To consider the relevance of the present trends in Hindi and their contemporary relevance.	4	-	H	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-3:	To help develop better understanding of the Hindi language by studying the stories with reference to current reality.	4	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-4:	To understand the usage of the present Advertising trends and its creative angles with the varied skills of Hindi Language.	4	H	-	H	H	H	-	-	-	-	-	H	-	-	-	-
CLO-5:	To make translation of good literature and any relevant document from the Hindi Language to English and Vice-versa.	4	-	H	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-6:	To help the learner to tackle Administrative terminologies, help them use Idioms and Phrases in their daily life, with ease.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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

UNIT – 1

1. KABIR (3Couplets)
2. SURDAS (3Couplets)
3. TULSIDAS (3Couplets)
4. THIRUVALLAVUR (3Couplets)
5. RAHIM (3Couplets)
6. SURYAKANTH TRIPATHI NIRALA - BADAL RAAG
7. NAGARJUN - PRETH KA BAYAAN
8. SOHANLAL DWEDI - LEHRON SE DARKAR NAUKA PAAR NAHI HOTI
9. MAKHANLAL CHATURVEDI - RASHTRA PREM
10. GOONGI MAA - AGNISHEKHAR

UNIT - 2

1. LADKIYAAN – MAMTA KALIYA
2. GUNDA – JAYSHANKAR PRASAD

UNIT – 3

1. VIGYAPAN

a. Bhumika aur Awdaharna
b. Shabd ki Vutpati
c. Paribhasha
d. Madhyam

UNIT – 4

1. TRANSLATION (HINDI TO ENGLISH AND ENGLISH TO HINDI)
2. LETTER WRITING

UNIT – 5

1. TECHNICAL TERMINOLOGY

Learning Resources	***The Prescribe Text Book Compiled and Edited by Department of Hindi*** *www.kavitakosh.org* *www.shabdkosh.com*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (100% 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	10%	10%	10%	10%	10%	10%	20%	10%	20%	-
Level 2	Understand	10%	10%	10%	10%	10%	10%	20%	10%	20%	-
Level 3	Apply	20%	20%	20%	20%	20%	20%	40%	20%	40%	-
Level 4	Analyze	10%	10%	10%	10%	10%	10%	20%	10%	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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. 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

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Course Code	ULF22G02J	Course Name	French-II	Course Category	G	Generic Elective Course	L	T	P	C
							2	0	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)

		Bloom's Level	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	PSO -1	PSO -2	PSO-3
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																
CLR-6:	*Extend and expand their savoir-faire through the acquisition of current scenario*																
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																
CLO-1:	*To acquire knowledge about French language*	4	H	H	H	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2:	*To strengthen the knowledge on concept, culture, civilization and translation of French*	4	-	H	-	H	-	-	-	-	-	-	M	-	-	-	-
CLO-3:	*To develop content using the features in French language*	4	H	-	-	H	-	-	-	-	-	-	H	-	-	-	-
CLO-4:	*To interpret the French language into other language*	4	H	-	H	H	H	-	-	-	-	-	H	-	-	-	-
CLO-5:	*To improve the communication, intercultural elements in French language*	4	-	H	-	H	-	-	-	-	-	-	H	-	-	-	-
CLO-6:	To enable the students to overcome the fear of speaking a foreign language and take position as a foreigner speaking French	4	H	-	-	H	H	-	-	-	-	-	-	-	-	-	-

Unité-I

Les loisirs -Les loisirs -Les activités quotidiennes -Les matières -Le temps et l'heure - Les fréquences- Les sons [u]/ [y] – Les loisirs – La routine – Mots et expressions – Exprimer ses gouts et ses préférence – Décrire sa journée

Unité-II

La routine - Les adjectifs interrogatifs - Les nombres ordinaux - L'heure - Le pronom personnel COD -Les pronominaux -Les verbes du premier groupe en –e_er,é_er,-eler,-eter -Le verbe prendre - Parler de ses gouts et de ses préférences - Décrire sa journée

Unité-III

Où faire ses courses ? -Les aliments - Les quantités - Les commerces et les commerçants - Demander et dire le prix - Les services - Les moyens de paiement - les sons [ã]/ [an] – Découvrez et dégustez ! Mots et expressions – Au restaurant : commander et commenter – Inviter et répondre à une invitation.

Unité-IV

Découvrez et dégustez Les articles partitifs -Le pronom en (la quantité) - Très ou beaucoup ? -La phrase négative (2) - C'est /Il est (2) - L'impératif - Il faut - Les verbes devoir, pouvoir, savoir, vouloir - Au restaurant : Commander et commenter - Inviter et répondre à une invitation

Unité-V

Tout le monde s'amuse- Les sorties - Situer dans le temps - La famille (2) - Les vêtements et les accessoires - Les sons [c]/[ɔn] - Les ados au quotidien - Les adjectifs démonstratifs - La formation du féminin (4) -Le pronom indéfini on -Le futur proche - Le passe composé -Les verbes du premier groupe en – yer -Les verbes voir et sortir Décrire une tenue – écrire un message amical.

Learning Resources	***Theory:*** 1. "**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.***

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (100% 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	10%	10%	10%	10%	10%	10%	20%	10%	20%	-
Level 2	Understand	10%	10%	10%	10%	10%	10%	20%	10%	20%	-
Level 3	Apply	20%	20%	20%	20%	20%	20%	40%	20%	40%	-
Level 4	Analyze	10%	10%	10%	10%	10%	10%	20%	10%	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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. C.Thirumurugan Associate Professor, Department of French, Pondicherry University	*1. Kumaravel K. Assistant Professor & Head, SRMIST*
		2. Ponrajadurai M Assistant Professor, SRMIST

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Course Code	UPY22201J	Course Name	*Physics-II*	Course Category	C	Professional Core Course	L	T	P	C
							3	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**
CLR-1:	Introduce vector calculus and its application to forces, fields and potentials	
CLR-2:	*Acquire knowledge of fundamental concepts electrostatics and electric field in matter*	
CLR-3:	*Learn fundamental concepts of electric field in matter and magnetic fields*	
CLR-4:	*Acquire analytical and problem solving skills on involving currents and magnetic field in matter*	
CLR-5:	*Use the knowledge of electric and magnetic fields to get basic idea of electromagnetic radiation.*	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	**Bloom's Level**
CLO-1:	*Apply vector calculus to solve problems involving forces and fields.*	4
CLO-2:	*Apply mathematical tools to explain electrostatic interactions.*	4
CLO-3:	*Solve problems related to charges, currents in vacuum and matter.*	4
CLO-4:	*Solve problems in magnetism that require knowledge of magnetic fields in matter.*	4
CLO-5:	*Apply fundamental concepts of electromagnetic phenomenon and radiation.*	4

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	ICT Skills	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
H	-	H	-	-	-	-	-	-	-	-	-	-	-	-
H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
-	-	H	-	-	-	H	-	-	-	-	-	-	-	-
H	-	-	-	-	-	H	-	-	-	-	-	-	-	-
H	-	-	H	-	-	-	-	-	-	-	-	-	-	-

Unit-1: Fundamental theorems on gradients and divergences, Fundamental theorem on curls, Dirac Delta function, Three dimensional Dirac delta function, Introduction to Cylindrical Coordinates (CC) and Spherical Polar Coordinates (SPC), Introduction to Gradient, divergence and curl in SPC and CC and their applications, Helmoltz theorem and potentials, Scalar and vector potentials, Coulomb's law, Electric field of discrete and continuous charge distributions.

1. Practice problem solving on E field of discrete and continuous charge distributions
2. Calibration of Voltmeter using Potentiometer
3. Calibration of Ammeter using Potentiometer

Unit-2: Divergence of electrostatic field, Gauss's law and applications, Line integral and Curl of Electrostatic field, Conservative nature of electrostatic field, Scalar electric potential, Poisson's and Laplace's equations, Potential of localized charge distribution, Boundary conditions, Work done to move charge, Energy of a point and continuous charge distribution, Basic properties of conductors and dielectrics, Uniqueness theorems, Method of images for calculating potentials

4. Practice problems on Gauss law, electric potential and method of images
5. Determination of Internal resistance of the given cell using Potentiometer
6. Determination of Temperature Coefficient of Resistance using Post Office Box

Unit-3: Polarization in Dielectrics, Induced dipoles and concept of bound charges, Electric Displacement, Gauss law in Dielectrics, Boundary Conditions at Dielectric interface, Susceptibility, Permittivity
Dielectric constant, Energy in dielectrics, Magnetic fields and force: Lorentz force law, Currents: Line, surface and volume current densities, Continuity equation, Biot-Savart law, Magnetic field due to Steady straight-line currents.

7. Practice problem solving on polarization, current density and Biot-Savart law
8. EMF of thermocouple Potentiometer
9. Comparison of EMFs of two cells using Ballistic Galvanometer

Unit-4: Divergence of magnetic field, Curl of magnetic field and Ampere's law, Applications of Ampere's law, Comparison with electrostatics, Magnetic vector potential and arbitrariness, Magnetostatic boundary conditions, Multipole expansion: Electric and Magnetic, Magnetization torque and force on magnetic dipoles, Bound currents: conceptual interpretation, Ampere's law in magnetized materials, Magnetic susceptibility and permeability, Introduction to Ferromagnetism and Magnetic domains.

10. Practice problems on Ampere's law, boundary conditions and magnetization
11. Determination horizontal component of earth magnetic field-Field along the axis of the coil

12. Determination of Magnetic moment and Ratio of magnetic moments by Searle's vibration magnetometer method
Unit-5: Ohm's law and EMF, Faraday's law and induced electric field, Energy in magnetic fields, Maxwell's modification of Ampere's law, Maxwell's equations in vacuum and matter, Boundary Conditions, Sinusoidal waves and complex notation Maxwell's equations, The wave equation for E and B in vacuum, Solution of the wave equation, Transverse nature of EM waves, Energy and momentum in EM waves, Continuity equation, Poynting's theorem. 13. Practice problems on Maxwell's equations and EM waves. 14. Study of resonance in series LCR circuits.Calibration of Voltmeter using Potentiometer 15. Study of resonance in parallel LCR circuits.Calibration of Ammeter using Potentiometer

Learning Resources	1. Introduction to Electrodynamics, 4th Ed., David J. Griffiths (Prentice Hall of India, 2012) 2. Principles of Physics,10th Ed, ISV, R.Resnick, J. Walker, D.Halliday (Wiley, 2015) 3. Electricity and Magnetism: Berkeley Physics Course Vol. 2, Edward M. Purcell (McGraw Hill Education, 2017)	4. University Physics: Electricity and Magnetism, (12th Ed., H. D. Young and R. A. Freedman, 2011) 5. Electromagnetics, Joseph Edminister (McGraw Hill, 2013) 6. Electricity and Magnetism, A Mahajan, (McGraw Hill Education, 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	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Level 2	Understand	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Level 3	Apply	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Level 4	Analyze	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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
Dr. M Sathish , CSIR-CECRI, msathish@cecri.re.in	Prof. C Vijayan, IIT Madras, cvijayan@iitm.ac.in	Dr. Rohit Dhir, SRMIST
Dr. DK Aswal , NPL, dkaswal@nplindia.org	Prof. V Subramanian, IIT Madras, manianvs@iitm.ac.in	Dr. C. Preferencial Kala, SRMIST

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Course Code	UCY22201J	Course Name	General Chemistry-II	Course Category	C	Core Course	L	T	P	C
							3	0	4	5

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 knowledge on the importance of basic organic chemistry
CLR-2:	enable the students to acquire quantitative skills in volumetric analysis.
CLR-3:	Inculcate the practical and theoretical knowledge about the chemical kinetics
CLR-4:	acquire knowledge in the fundamentals of electrochemistry
CLR-5:	promote the importance of industrial chemistry

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning Bloom's Level	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	ICT Skills	Life Long Learning	PSO -1	PSO -2	PSO-3
CLO-1:	understand the basic concepts of organic chemistry	4	H	-	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-2:	gain knowledge and practical skill in the quantitative analysis of wide range of compounds	4	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-3:	acquaint the fundamental concepts of chemical kinetics with the practical knowledge	4	H	-	-	-	M	-	-	-	-	-	-	-	-	-	-
CLO-4:	Apply the concepts of electrochemistry with the real time analysis	4	-	-	H	H	-	-	-	-	-	-	-	-	-	-	-
CLO-5:	utilize their chemistry knowledge for industrial applications	4	-	-	-	H	H	-	H	-	H	-	-	-	-	-	-

UNIT- I: Carbohydrates, Benzene and Heterocyclic Compounds

Classification of carbohydrates–Properties and uses of glucose and fructose mutarotation - Chemistry of benzene - Preparation, mechanism of electrophillic substitution reactions. Heterocyclic compounds– Preparation and properties of pyrrole and pyridine.

PRACTICALS:

1. Estimation of ascorbic acid
2. Estimation of phenol
3. Estimation of aniline

UNIT- II: PRINCIPLES OF VOLUMETRIC ANALYSIS:

Definitions of Molarity, Molality, Normality and Mole Fraction - Their Calculations - Definition and Examples for Primary and Secondary standards - Calculation of Equivalent Weight of Acid, Base, Oxidising Agent, Reducing Agent and Salts.

Principles of Volumetric Analysis - Theories of Acid- Base, Redox, Complexometric Iodometric and Iodimetric titrations.

Theories of indicators - Acid-base indicators - Choice of indicators - Redox, Metal ion and Adsorption indicators.

PRACTICALS:

1. Estimation of HCl using standard oxalic acid
2. Estimation of NaOH using standard sodium carbonate
3. Estimation of $FeSO_4$ using standard oxalic acid

UNIT- III: Chemical Kinetics

Rate of reaction, order- molecularity, first order rate law and simple problems- Half-life period of first order reaction- pseudo first order reaction- zero and second order reactions. Arrhenius and collision theories.

PRACTICALS:

1. Kinetics of Iodination of Acetone
2. Determination of rate constant of acid –catalysed hydrolysis of an ester
3. Comparison of rate constant of hydrolysis of an ester reaction using two acids.

UNIT –IV: Electrochemistry

Faradays laws of electrolysis - Specific conductance, equivalent conductance - Cell constant - Arrhenius theory Ostwald"s dilution law and Kohlrausch law - Nernst equation - Applications of EMF- Measurements.

PRACTICALS:

1. Determination of concentration of an acid by conductometric method.
2. Determination of concentration of the mixture of acids by conductometric method.
3. Estimation of Iron by potentiometric method.

UNIT - V: Industrial Chemistry

Hardness of water – Temporary and permanent hardness, disadvantages of hard water Boiler scales and sludges - Softening of hard water – Zeolite process - demineralization process and reverse osmosis – Purification of water for domestic use: use of chlorine, Ozone and UV light.

PRACTICALS:

1. Estimation of Chloride in the given water sample.
2. Estimation of Nickel using decinormal solution of EDTA
3. Estimation of hardness in the given water sample

Learning Resources	Theory: 1. Puri B.R., Sharma L.R., Kalia K.K., Principles of Inorganic Chemistry, Shobulal Nagin Chand and Co, 2001. 2. R. Gopalan, S. Sundaram, Allied Chemistry, Sultan Chand and Sons, 1995. 3. Lee, J.D., Concise Inorganic Chemistry, Fifth Edn., Wiley India. 4. Huheey, J.E., Keiter, E.A., Keiter, R. L., Medhi, O.K., Inorganic Chemistry- Principles of Structure and Reactivity, Pearson Education 2009.	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, 1989 (John Wiley and Sons Inc, 605 Third Avenue, NewYork NY 10158) 2. V.Venkateswaran, R. Veeraswamy, A.R.Kulandaivelu, *Basic Principles of Practical Chemistry*, 2nd Edition Sultan Chand and Sons,1997. 3. Daniels et al., *Experimental Physical Chemistry*, 7th edition, New York, McGraw Hill, 1970.

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	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Level 2	Understand	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Level 3	Apply	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Level 4	Analyze	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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	Dr. J. Arockiaselvi, SRMIST
	Dr. Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru Email: kanishka@jncasr.ac.in	Prof. M. Arthanareeswari, SRMIST

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Course Code	UMA22201T	Course Name	Mathematics-II	Course Category	C	Professional Core Course	L	T	P	C
							3	1	0	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:	Bloom's level
CLR-1:	Learn the concept of Matrices	
CLR-2:	Apply the concepts Eigen values and Eigen vectors to diagonalize a matrix, to reduce it to orthogonal form,	
CLR-3:	Learn various methods to find the roots of an equation	
CLR-4:	Apply the concept of Differential Equations in problems of Science	
CLR-5:	Apply the concept of Taylor series, composite function and Jacobian in problems of science	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Bloom's level	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	ICT Skills	Life Long Learning	PSO -1	PSO -2	PSO-3
CLO-1:	Understand the concept of Matrices and apply them to solve system of linear equations	4	H	M	M	M	-	-	-	-	-	-	-	M	-	-	-
CLO-2:	Apply the knowledge of Matrices, Eigenvalues and Eigen Vectors, Reduce to Quadratics form to solve problems in field of science	4	H	H	M	H	-	-	-	-	-	-	-	H	-	-	-
CLO-3:	Solve the equations and find their roots applying various methods	4	H	H	M	H	-	-	-	-	-	-	-	H	-	-	-
CLO-4:	Gain knowledge in solution of Differential Equations and Its applications	4	H	H	M	H	-	-	-	-	-	-	-	H	-	-	-
CLO-5:	Gain familiarity in the knowledge of Jacobian, and Taylor series and apply them to the problems involving Science	4	H	M	M	M	-	-	-	-	-	-	-	M	-	-	-

Unit-1: Introduction to matrices- Types of matrices- Properties- Inverse of matrix- System of linear equation – Cramer's rule- Rank of matrix- Existence and uniqueness of the system of linear equation by rank.

Unit-2: Characteristic equation- Eigen values and Eigen vectors of a real matrix- Cayley Hamilton theorem- Orthogonal reduction of a symmetric matrix to diagonal form.

Unit-3: Polynomial equations- Irrational roots- Complex roots(up to third order)- reciprocal equations- Approximation of a roots of a polynomial equation- Newton's method- finding positive roots- Horner's method for finding the roots

Unit-4: First order differential equation- Variable separable method- substitution method- Homogeneous differential equation- First order linear differential equation- Application of first order differential equation

Unit-5: Introduction- Functions of two variables – Euler's theorem- Total derivative- Taylor's expansion with two variable up to second order terms- Jacobian of two and three variables

Learning Resources

1. Erwin kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2010.
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2010.
3. Hughes-Hallett et al., Calculus - Single and Multivariable, 8th Edition, John-Wiley and Sons 2020.
4. James Stewart, Calculus, 5th Edition, Thomson, 2003.
5. T. M. Apostol, Calculus, Volumes 1 and 2 (2nd Edition), Wiley Eastern 1991.
6. T.K. Manicavachagam Pillai, T. Natarajan, K.S. Ganapathy, Algebra, Vol. I, S. Viswanathan Pvt Limited, Chennai, 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	20%	-	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-

Level 5	Evaluate										-
Level 6	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
Mr. Madhan Shanmugasundaram , Director, Infosys Technologies, Chennai madshan@gmail.com	*Prof. Y.V.S.S. Sanyasiraju,* ***IIT Madras, sryedida@iitm.ac.in***	Dr.B.Vennila, SRMIST
	Prof. B. V. Rathish Kumar, IIT Kanpur, bvrk@iitk.ac.in	*Dr. E. Sujatha, SRMIST*

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Course Code	UBT22202J	Course Name	Biology-II	Course Category	C	Professional Core Course	L	T	P	C
							3	0	2	4

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

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

		Bloom's Level
CLR-1 :	know the importance of nutrition and the various forms it is undertaken	
CLR-2 :	understanding the necessity and importance of gaseous exchange in organisms	
CLR-3 :	know the various transport mechanisms present in plants and animals	
CLR-4 :	provide a basic idea of the ecology and its effect on the biosphere	
CLR-5 :	gain knowledge on the evolutionary path taken by the organisms over a period of time	

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Bloom's Level	1 Disciplinary Knowledge	2 Critical Thinking	3 Problem Solving	4 Analytical Reasoning	5 Research Skills	6 Team Work	7 Scientific Reasoning	8 Reflective Thinking	9 Self-Directed Learning	10 Multicultural Competence	11 ICT Skills	12 Life Long Learning	13 PSO -1	14 PSO -2	15 PSO-3
CLO-1 :	candidate gains knowledge on the various nutrition patterns in the living organism	*4*	*H*	-	-	-	-	-	-	-	-	-	-	*H*	-	-	-
CLO-2 :	helps the candidate in knowing the function of respiration	*4*	*H*	-	-	-	-	-	-	-	-	-	-	*H*	-	-	-
CLO-3 :	the candidate will gain knowledge on the transport mechanisms in plant and animals	*4*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	the candidate will come to know the importance of ecology and its conservation	*4*	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	evolutionary study will give the candidate knowledge on processes undergone during the evolutionary process	*4*	*H*	-	-	-	-	-	*H*	-	-	-	-	-	-	-	-

UNIT- I: **Heterotropic** Nutrition
Forms of heterotropic nutrition, Feeding mechanisms, Dietary reference values, Malnutrition
PRACTICALS
1. Measuring rates of photosynthesis
2. To investigate gaseous exchange in leaves

UNIT- II: Gaseous Exchange
Cell Respiration- Aerobic, Anaerobic, Gaseous exchange in invertebrates, Mammals
PRACTICALS
1. Use of respirometer to measure oxygen uptake in small invertebrates
2. To investigate the oxidation of a krebs cycle intermediate

UNIT- III: Transport
Plant water relations, Transpiration, Ascent of water in Xylem, Blood Vascular system, oxygen transport
PRACTICALS:
1. To Investigate Osmosis In Living Plant Cells
2. To determine the water potential of a plant tissue

UNIT–IV: Ecology
Approaches to ecology, Energy flow and Biogeochemical cycles, Food webs, Ecological pyramids, Community ecology, population ecology
PRACTICALS
1. To investigate the air content of a soil sample
2. To investigate the relative proportions of solid particles in a soil sample
3. To investigate the pH of soil and water samples

UNIT - V: Evolution- history of life
Theories of origin of evolution, Nature of the earliest organisms, Theory of evolution, Natural selection, Evidence for theory of evolution

Learning Resources	1. **D.J. Taylor, N.P.O. Green, G.W.Stout. Biological Science, Cambridge Publications** 2. **Lisa A. Urry, Michael L. Cain, Steven Alexander Wasserman, Peter V. Minorsky, Rebecca B. Orr · Pearson. Campbell Biology.**

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	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Level 2	Understand	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Level 3	Apply	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Level 4	Analyze	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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 Higher Technical Institutions	**Internal Experts**
1.Dr. M. Sujatha, Associate Professor & HOD, Department of Biotechnology, Ethiraj College for Women, Chennai 2.Dr. SUMATHI, Associate Professor, SRMC, Porur, Chennai	**Dr. N. Prasanth Bhatt, SRMIST**

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Course Code	UJK22201L	Course Name	Communication Skills	Course Category	JK	Life Skill Course	L	T	P	C
							0	0	4	2

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning
CLR-1:	*To make the students learn the native speakers' accent.*	Bloom's Level
CLR-2:	*To educate them about word stress of English*	
CLR-3:	*The enable them to participate in group discussion and debates*	
CLR-4:	To improve the listening and speaking abilities in English	
CLR-5:	*LSRW skills all together is developed in every student*	

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning	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
CLO-1:	*Master the sound systems of English*	4	H	-	-	-	-	-	-	-	-	-	-	-	-	-	*H*
CLO-2:	*Have a better Word stress, Rhythm and Intonation*	4	H	-	-	-	-	-	-	-	-	-	-	-	-	-	H
CLO-3:	*Develop Neutral Accent*	4	H	-	-	-	-	-	-	-	*H*	-	-	-	-	-	-
CLO-4:	*Participate in any conversation with any native speaker*	4	H	-	-	-	-	-	-	-	-	-	-	*H*	-	-	-
CLO-5:	*Clear any standardized tests conducted to measure the English language ability like IELTS and TOEFL*	4	H	-	-	-	-	-	-	-	-	-	-	-	-	-	*H*

UNIT I

Listening

Techniques of effective listening

Listening and comprehension

Probing questions

Barriers to listening

Speaking

Pronunciation

Enunciation

Vocabulary

Fluency

Common Errors

UNIT II

Reading

Techniques of effective reading

Gathering ideas and information from a given text

I. Identify the main claim of the text
II. Identify the purpose of the text
III. Identify the context of the text
IV. Identify the concepts mentioned

Evaluating these ideas and information

I. Identify the arguments employed in the text
II. Identify the theories employed or assumed in the text

Interpret the text

I. To understand what a text says
II. To understand what a text does
III. To understand what a text means

UNIT III

Writing and different modes of writing

i) Clearly state the claims
ii) Avoid ambiguity, vagueness, unwanted generalizations and oversimplification of issues
iii) Provide background information
iv) Effectively argue the claim
v) Provide evidence for the claim

vi) Use examples to explain concepts
vii) Follow convention
viii) Be properly sequenced
ix) Use proper signposting technique
x) Be well structured
a. Well-knit logical sequence
b. Narrative sequence
C. Category groupings

xi) Different modes of writing
E-mails
Proposal writing for higher studies
Recording the proceedings of meeting
Any other mode of writing relevant for learners

UNIT IV

Digital Literacy

Role of digital literacy in professional life
Trends and opportunities in using digital technology in workplace
Internet basics
Introduction to MS Office tools

I. Paint
II. Office
III. Excel
IV. Powerpoint

Effective use of social media

Introduction to social media websites
Advantages of social media
Ethics and etiquettes of social media
How to use Google search better
Effective ways of using social media
Introduction to Digital marketing

UNIT V

Non-verbal communication

Meaning of non-verbal communication
Introduction to modes of non-verbal communication
Breaking the misbeliefs
Open and closed body language
Eye contact and facial expression
Hand gestures

Learning from experts

Activities based learning

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*** 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* ***6.*** *https://www.assessmentday.co.uk/aptitudetests_verbal.htm*

	Bloom's Level of Thinking	Continuous Learning Assessment (100% weightage)							
		CLA – 1 (20%)		CLA – 2 (20%)		CLA – 3 (30%)		CLA – 4 (30%)#	
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	-	10%	-	10%	-	10%	-	10%
Level 2	Understand	-	10%	-	10%	-	10%	-	10%
Level 3	Apply	-	40%	-	40%	-	40%	-	40%
Level 4	Analyze	-	40%	-	40%	-	40%	-	40%
Level 5	Evaluate	-	-	-	-	-	-	-	-
Level 6	Create	-	-	-	-	-	-	-	-
	Total	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	
External Experts	Internal Experts
Prof. Daniel David, Prof & Head, Department of English, MCC, Chennai	*Dr. Shanthichitra, Associate Professor, & Head, Department of English, FSH, SRMIST*
	Dr K B Geetha, Assistant Professor, Department of English, FSH, SRMIST

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Course Code	***UNS22201L / UNC22201L / UNO22201L / UYG22201L***	**Course Name**	***NSS/NCC/NSO/YOGA***	**Course Category**	**EA**	**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	UCY22301J	Course Name	Solution chemistry, Phase equilibria and Surface chemistry	Course Category	C	Core Course	L	T	P	C
							4	0	4	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:
CLR-1:	gain knowledge about the laws of distribution and its applications
CLR-2 :	acquire knowledge about miscibility of liquids and CST of a system
CLR-3 :	understand about the importance of ionic equilibria, pH, solubility product
CLR-4 :	infer the various phase equilibria existing in a system
CLR-5 :	understand about the surface chemistry and catalysis

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
			Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	ICT Skills	Life Long Learning	PSO -1	PSO -2	PSO-3
CLO-1 :	state laws of distribution and determine the distribution and partition coefficient	4	H	-	H	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	differentiate types of solutions and determine the CST of a system	4	H	-	H	-	H	-	-	-	-	-	-	-	-	-	-
CLO-3 :	explain theory of acids and bases and estimate the pH, solubility product	4	H		H		M	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Illustrates the existence of phase equilibria and construct & interpret the phase diagram	4	H	H	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Classify adsorption isotherms and validate the adsorption isotherm of a system & estimate the rate constant of acid catalyzed reaction	4	H	H	-	-	-	-	H	-	-	-	-	-	-	-	-

UNIT- I: Nernst Distribution Law and Solutions

Nernst Distribution Law – Thermodynamical derivation of Distribution Law – Calculation of Partition Coefficient – Deviation from Distribution Law due to Molecular complexity-degree of dissociation – Distribution Law and Henry's Law.

Forces in liquids – Solutions of liquids in liquids – Ideal solutions – vapour pressure of an ideal solutions-Raoult's Law – Thermodynamics of an Ideal solution – criteria for an ideal solution – Non-Ideal or Real Solutions – Deviations from Ideal behaviour – Duhem-Margules equation with derivation – Konovalov's Rule.

PRACTICALS:

1. Distribution of acetic acid/benzoic acid between water and benzene or chloroform or cyclohexane.
2. Partition coefficient of Iodine between benzene and water.
3. Partition coefficient of ammonia between water and chloroform

UNIT- II: Binary Solutions

Fractional distillation of Binary miscible liquid - Solution of type I, II and III - Lever rule and distillation of immiscible liquids - Solubility of partially Miscible liquids - CST and Phenol – water system, Aniline- Hexane system, Triethylamine- Water system, Solution of gaseous in liquids, Factors influencing the solubility of gas, Correlation between Henry and Raoult's law.

PRACTICALS:

1. Determination of critical solution temperature and composition at CST of the phenol water system and to study the effect of impurities of NaCl and succinic acid on it.
2. Study of the effect of impurities of NaCl and succinic acid on CST of the phenol water system.
3. Determination of molecular formula of copper-ammonia complex by distribution method.
   Cu^{2+} (aq) + $nNH_3 \rightleftharpoons [Cu(NH_3)n]^{2+}$

UNIT III Ionic Equilibria

Strong, moderate, and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-, di-and triprotic acids (exact treatment). Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH and pK_a for different salts. Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Qualitative treatment of acid – base titration curves (calculation of pH at various stages).

PRACTICALS:

1. Determination of concentration of an acid using pH meter.
2. Determination of dissociation constant of weak acids by conductometry.
3. Determination of pH of a buffer solution by potentiometry.
4. Determination of solubility product of sparingly soluble salt by potentiometry

UNIT- IV: Phase Equilibria

Introduction to Phase rule and its components – Degree of freedom - Conditions for equilibrium between phases – Derivation of Gibbs phase rule for reactive and non-reactive systems – Phase diagrams – One component system - Clausius-Clapeyron equation - Meta stable equilibrium, effect of change of P and T - Comparison between the phase diagram of CO_2 and Water. Two component system involving solid-liquid equilibrium- Thermal analysis cooling curve – Lever rule – Lead-Silver system – Freezing point diagrams of compound formation with congruent melting points - Zinc-Magnesium system – Applications of Eutectics – Systems involving formation of compounds with Incongruent melting points-Sodium chloride-water system – Binary system with solid solution – completely miscible solid solution-The copper-Nickel system – partially miscible solid solution-Lead-Tin system – Gas-Solid equilibria-water-copper sulphate system.

PRACTICALS:

Construction of the temperature – composition phase diagram for

1. Azeotropic systems
2. Simple eutectic system
3. Congruent melting system

UNIT- V: Surface Chemistry and catalysis

Introduction to surface chemistry – adsorption – applications. Factors influencing the adsorption – Freundlich adsorption – Langmuir theory of Adsorption – BET theory of multilayer Adsorption – Types of adsorption Isotherms.

Catalyst, catalysis, and auto catalysis Types of catalyst Acid-base catalysis Kinetics of acid-base catalysis reaction - Enzyme catalyzed reaction - Michaelis-Menten mechanism - Mechanism of catalyzed reaction at the surface- Langmuir-Hinshelwood mechanism - Kinetics of surface reaction- Kinetics of bimolecular reaction derivation- Effect of temperature on heterogeneous reaction- Temperature effect on uni and bimolecular reactions- pH dependence of rate constant and derivation.

PRACTICALS:

1. Adsorption of oxalic acid/acetic acid on charcoal
2. Brunauer-Emmett-Teller (BET) surface are analysis
3. Determination of rate constant of acid catalyzed hydrolysis of an ester by conductometric method.

	Theory:	**Practicals:**
Learning Resources	1. *Engel, T. & Reid, P. Physical Chemistry 3rd Ed., Prentice-Hall, 2012.* 2. *Peter Atkins & Julio De Paula, Physical Chemistry 9th Ed., Oxford University Press 2010.* 3. Castellan, G. W. Physical Chemistry, 4th Ed., Narosa , 2004	1. *Jeffery, G.H., Bassett, J., Mendham, J., Denney, R.C.,Vogel's Textbook of Quantitative Chemical Analysis, 5th Edn., Longman Scientific & Technical, England, 1989 (John Wiley and Sons Inc, 605 Third Avenue, NewYork NY 10158)* 2. *V.Venkateswaran, R. Veeraswamy, A.R.Kulandaivelu, Basic Principles of Practical Chemistry, 2nd Edition Sultan Chand and Sons,1997.* 3. *Daniels et al., Experimental Physical Chemistry, 7th edition, New York, McGraw Hill, 1970.*

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	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Level 2	Understand	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Level 3	Apply	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Level 4	Analyze	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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	Prof. M. Arthanareeswari, SRMIST
	Dr. Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru Email: kanishka@jncasr.ac.in	Dr. J. Arockia Selvi, SRMIST

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Course Code	UCY22302T	Course Name	Basic concepts in organic chemistry	Course Category	C	Core Course	L	T	P	C
							4	0	0	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 knowledge on the importance of basic organic chemistry.
CLR-2 :	Acquire knowledge about IUPAC nomenclature and reaction intermediate.
CLR-3 :	Strengthen their knowledge in chirality.
CLR-4 :	Know about different reaction mechanisms.
CLR-5 :	Acquire in-depth understanding about the elimination and substitution reactions.

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
			Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	ICT Skills	Life Long Learning	PSO -1	PSO -2	PSO-3
CLO-1 :	Understand the basic concepts of organic chemistry including IUPAC nomenclature and reaction intermediate.	4	H	-	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-2 :	Gain knowledge about the acid-base and chirality.	4	H	H	-	H	-	-	H	-	-	-	-	H	-	-	-
CLO-3 :	Understand conformations of molecules and their applications.	4	H	H	M	H	-	-	-	-	-	-	-	H	-	-	-
CLO-4 :	Know about the aromaticity and basic reaction mechanisms.	4	H	-	M	H	-	-	-	-	-	-	-	H	-	-	-
CLO-5 :	Acquire in-depth understanding about the elimination and substitution reactions.	4	H	H	-	M	-	-	H	-	-	-	-	H	-	-	-

UNIT- I: IUPAC Nomenclature and Reaction Intermediate

Introduction to Periodic Table: orbital energy and reactivity, Structure and hybridization. IUPAC Nomenclature; introduce inductive; Resonance; Mesomeric effects and Hyperconjugation; bond cleavage: homolytic and heterolytic cleavage; stability of carbocation, carbanion, radicals, nitrenes, benzynes, synthesis of these intermediates.

UNIT-II: Organic Acid-Base

Concept of dipole moment, Acidity and Basicity and related pKa values: alcohols, amines, heterocycles, aliphatic and aromatic hydrocarbons, organic acids, mono and diesters, aldehydes and ketones, acidity of a-proton of acid, ester, and amide.

UNIT- III: Chirality, Projection Formulas and Conformational Analysis

Isomerism: structural isomerism; positional; branch; functional group; E/Z. Stereochemistry: Optical Activity and Optical Isomerism; Asymmetry; dissymmetry; point group; Chirality: Enantiomers, Diastereomers; R/S, D/L, axial chirality: allene and biphenyl; topicity: homotopic; enantiotopic; diasterotopic; Walden inversion.

Projecttion formulas and their interconversion.

Conformational analysis: alkane (up to butane), cycloalkane (cyclopropane; cyclobutane; cyclopentane; cyclohexane; cyclooctane); detail conformational analysis of mono-, di-, tri-substituted cyclohexanes with alkyl; halogen; hydroxyl substituents; Baeyer Strain Theory, Torsional strain.

UNIT- IV: Aliphatic and Aromatic Hydrocarbons, Aromaticity

Aliphatic hydrocarbons: alkane; alkene and alkyne; bond energies; combustion energy; aromatic hydrocarbons: comparison bond length and bond energy; aromaticity: Huckel rule, introduce aromatic, antiaromatic, nonaromatic, homoaromatic

UNIT-V: Elimination and Substitution Reactions

Concept of electron flow; significance of curly arrows in a reaction mechanism; kinetic isotope effect.

Elimination reaction: all types of mechanisms including substrate scope (E1, E2 and E1CB); effect of solvents; scopes for the synthesis of alkene and alkynes; Hofmann-elimination reaction; Cope elimination.

Substitution reaction: introduce nucleophile; electrophile; aliphatic substitution reaction: SN1, SN2, NGP, SNi, nucleophilicity of halides; chalcogens; and oxygenated conjugate bases; solvent effects; substitution effects; leaving groups; good and bad leaving groups; phase transfer catalyst used in substitution reaction.

Learning Resources	Theory:
	1. M. B. Smith and J. March, March's Advance Organic Chemistry, 6th Ed., John Wiley and Sons, Inc.
	2. J. Clayden, N. Greeves, and S. Warren, Organic Chemistry 2nd Ed., Oxford.

	3. J. McMurry, Organic Chemistry 5th Ed., Thomson. 4. T. W. G. Solomons and C. B. Fryhle, Organic Chemistry 10th Ed., John Wiley and Sons, Inc. 5. I. L. Finar and A. L. Finar, Organic Chemistry Vol. 2, Addison-Wesley. **6.** D. N. Nasipuri, Stereochemistry of Organic Compounds: Principles & Applications South Asia Books.

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	20%	-	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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	Dr. S. Pramanik, SRMIST
	Dr. Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru Email: kanishka@jncasr.ac.in	Prof. M. Arthanareeswari, SRMIST

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Course Code	UCY22303T	Course Name	Atomic Structure, Periodicity and Chemical Bonding	Course Category	C	Core course	L	T	P	C
							4	0	0	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 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
			Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	ICT Skills	Life Long Learning	PSO -1	PSO -2	PSO-3
CLO-1:	Utilize the knowledge of quantum mechanics to understand the atomic structure	4	H	-	H	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2:	Correlate the periodic properties of elements with their chemical properties	4	-	H	-	H	-	-	-	-	-	-	-	-	H	-	-
CLO-3:	Understand the concept of lattice energy using Born-Landé and Kapustinskii expression and Born-Haber cycle	4	H	-	-		-	-	-	-	-	-	-	-	H	-	-
CLO-4:	Perceive the importance of structures and geometries of molecules using VSEPR and MO theory	4	H	-	-	-	H	-	-	-	-	-	-	-	H	-	-
CLO-5:	Rationalize the properties of semiconductor using metallic bonding and gaseous behavior using weak chemical forces	4	-	H	-	H	-	-	-	-	-	-	-	-	-	H	-

Unit I: Theory of Atomic Structure

Introduction to Atomic Structure (Brief details of Dalton, J. J. Thomson and Rutherford's atomic model), Bohr's atomic model and line spectrum of hydrogen atom, Wave mechanics – duality of matter, de Broglie equation, Heisenberg's Uncertainty Principle, Failure of Bohr's atomic model, Derivation of Schrödinger's wave equation (Time-Independent equation only), Significance of ψ and ψ2, Probability distribution curves, Radial and angular wave functions and nods, Shapes of orbitals, quantum numbers, Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau principle, Electronic configuration of elements

Unit II: Periodic properties

Groups and Periods in the Periodic Table, Slater rules – Calculation of Effective nuclear charge and shielding constant, Trend of the periodic table properties: a) atomic radii b) ionic radii c) ionization energy d) electron affinity e) electronegativity - Pauling, Allred Rochow, Mulliken's scales, f) metallic character g) oxidation state h) chemical properties.

Unit III: Chemical Bonding – Ionic bond

Types of chemical bonds, Definition and General characteristics of Ionic bond, Ionic crystal formation – closed packing, Radius ratio rule and its applications - Derivation for AX3 type compound, Lattice energy - Born-Lande equation, Kapustinskii Equation, Madelung constant, Born-Haber cycle and its applications, Relationship between lattice energy and solubility of ionic compounds, Covalent character in ionic compounds, Polarization, Polarizing power, dipolemoment, Fajan's Rule and applications.

Unit IV: Covalent Bonding

Lewis theory-Octet rule, Valence Bond theory - Postulates and limitations, Types of hybridization, VSEPR theory to predict the type of hybridization and geometry of molecules, Molecular Orbital Theory, LCAO method, formation of bonding, anti-bonding and nonbonding molecular orbitals, Types of overlapping - S-S ,S-px, Px-Px, Py-Py and Pz-Pz, M. O diagram for homonuclear and heteronuclear diatomic molecule (H2+,H2, He2+, He2, Li2, B2, C2, N2, O2, O2-, O22-, CO, HCl), calculation of bond order.

Unit V: Metallic bond, Van der Walls Force, Hydrogen bonding
Introduction to metallic bond, Electron sea theory, Conductor, Insulator, Semiconductor - Band Theory, Van der Waals forces: ion-dipole force, dipole-dipole forces, dipole-induced dipole forces, Instant dipole-Induced dipole forces (London forces) - Types of hydrogen bonding, VB approach to hydrogen bonding, Effects of hydrogen bonding in density, solubility, melting point and boiling point.

Learning Resources	**Theory:** 1. Lee, J.D., Concise Inorganic Chemistry, Fifth Edn., Wiley India. 2. Huheey, J.E., Keiter, E.A., Keiter, R. L., Medhi, O.K., Inorganic Chemistry- Principles of Structure and Reactivity, Pearson Education 2009. 3. Douglas, B.E., McDaniel, D.H., Alexander, J.J., 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 Edition 2010, W. H. Freeman and Company, 41 Madison Avenue, New York, NY 10010, www.whfreeman.com. 5. Miessler, Gary L., Fischer Paul J., Tarr, Donald A., Inorganic Chemistry, Fifth edition, Pearson, 2014. 6. Textbook of Inorganic Chemistry, P.l. Soni, Mohan Katyal,Sultan Chand & Sons Publishers. 7. Satyaprakash, G.D. Tuli, S. K. Basu, R.D. Madan, Advanced Inorganic Chemistry – I Sultan Chand & Sons Publishers.

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	20%	-	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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	*1. Prof. G. Sekar, IIT Madras, gsekar@iitm.ac.in*	1. Prof. Dr. M. Arthanareeswari, SRM IST
	2. Prof. Vivek Polshettiwar, TIFR Mumbai, vivekpol@tifr.res.in	*2. Dr. M. Ganesh Pandian, SRM IST*

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Course Code	UCY22S01T	Course Name	Materials Chemistry	Course Category	S	Skill enhancement Course	L	T	P	C
							2	0	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:	Deepen the knowledge on crystalline materials with a focus on their synthesis methods	
CLR-2:	Improve the understanding of amorphous, electronic materials and their applications	
CLR-3:	Understand the fundamentals of nanomaterials 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:	Level of Thinking (Bloom)	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	ICT Skills	Life Long Learning	PSO -1	PSO -2	PSO-3
CLO-1:	Understand different types of materials, their properties, characterization and applications	4	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-2:	Well aware of various chemical, physical methods of crystalline materials synthesis	4	H	H	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-3:	Gain knowledge about amorphous materials, polymer materials and band theory of solids	4	H	-	-	-	-	-	-	-	-	-	-	-	-	H	-
CLO-4:	Familiar with the mechanical, magnetic and electrical properties of the materials and their technological relevance	4	-	H	-	M	-	H	-	-	-	-	-	-	-	-	-
CLO-5:	Identify the suitable analytical techniques and perform the characterization of materials	4	H	-	H	-	-	-	H	-	-	-	-	-	-	-	-

UNIT- I: Crystalline materials

Introduction, Fundamentals of lattice, Unit cell, atomic coordinates, Bravais lattices, synthetic approaches for crystalline functional materials: Chemical methods, Physical methods.

UNIT- II: Amorphous solids

Introduction, A comparison of crystalline and amorphous materials in terms of properties and applications, oxide glasses, chalcogenide glasses, amorphous carbon, diamond, graphite, alkaline graphite, polymer compounds: Examples and applications, band theory of solids, Insulators, semiconductors, Super conductivity, optical properties of materials, Band gap of materials and its correlation with optical properties, Concept of doping and different types of dopant materials, Effect of doping on optical properties of materials, Devices based on optical properties of materials.

UNIT- III: Nanomaterials

Introduction, Examples of a variety of nanomaterials, Quantum confinement, surface energy of nanomaterials, fabrication methods of nanomaterials, Top down and bottom-up approaches, Classification of nanomaterials, applications, porous materials, soft materials, amorphous materials, luminescent materials.

UNIT- IV: Properties of Nanomaterials

Mechanical properties: Ductile fracture, brittle fracture, toughness, Impact testing, magnetic properties of materials: Para magnetic properties, Ferro magnetic properties, anti-ferro magnetic properties, Ferri magnetic properties, Thermoelectric properties: dielectric properties, Piezoelectric properties, Pyroelectric properties, ferroelectric effect, Thermal properties: Glass transition temperature.

UNIT- V: Characterization of Nanomaterials

Spectroscopic methods: UV-Vis: Instrumentation, basic working principles, IR: Instrumentation, basic working principles, X-ray diffraction: Instrumentation, basic working principles, Electron microscopy: SEM, Instrumentation, basic working principles, Electron microscopy: TEM, Instrumentation, basic working principles, XPS: Instrumentation, basic working principles, Probe Analysis, AFM: Instrumentation, basic working principles

Learning Resources

1. **Theory:** 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

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	20%	-	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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	Dr. Srinivasa Rao Kancharla, SRMIST
	Dr. Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru Email: kanishka@jncasr.ac.in	Dr. T. Pushpa Malini, SRMIST

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Course Code	UES22AE1T	Course Name	Environmental Studies	Course Category	AE	Ability Enhancement Course	L	T	P	C
							3	0	0	3

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:	To teach the importance of environment
CLR-2:	To impart the knowledge about ecosystem
CLR-3:	To teach about Biodiversity
CLR-4:	To create awareness about environmental pollution
CLR-5:	To understand about Environment Protection

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 Disciplinary Knowledge	2 Critical Thinking	3 Problem Solving	4 Analytical Reasoning	5 Research Skills	6 Team Work	7 Scientific Reasoning	8 Reflective Thinking	9 Self-Directed Learning	10 Multicultural Competence	11 ICT Skills	12 Life Long Learning	13 PSO -1	14 PSO -2	15 PSO-3
CLO-1:	To gain knowledge on the importance of natural resources and energy	4	-	-	-	-	-	H	H	-	-	-	-	H	-	-	-
CLO-2:	To understand the structure and function of an ecosystem	4	-	-	-	-	-	H	-	-	-	-	-	H	-	-	-
CLO-3:	To imbibe an aesthetic value with respect to biodiversity, understand the threats and its conservation and appreciate the concept of interdependence	4	-	-	-	-	-	-	H	-	-	-	-	-	-	-	-
CLO-4:	To understand the causes of types of pollution and disaster management	4	-	-	-	-	-	-	H	-	-	-	-	-	-	-	-
CLO-5:	To observe and discover the surrounding environment through field work	4	-	-	-	-	-	H	-	-	-	-	-	H	-	-	-

UNIT I - INTRODUCTION TO NATURAL RESOURCES/ENERGY

Natural Resources – Definition – Scope and Importance – Need for Public Awareness – Renewable and Non-renewable Resources: Natural resources and associated problems. Forest resources and over-exploitation – Water resources and over-utilization – Mineral resource extraction and its effects - Food resources - food problems and Modern agriculture - Energy resources and its future.

UNIT II – ECOSYSTEMS

Concept of an ecosystem-structure and function of an ecosystem-producers, consumers and decomposers- ecological succession- food chains (any 2 Examples)- food webs(any 2 Examples)-ecological pyramids.

UNIT III-ENVIRONMENTAL POLLUTION /DISASTER MANAGEMENT

Definition-causes, effects and control measures of : Air, Water and Soil pollution- e-waste management- Disaster management: Natural and man-made-food/earthquake/cyclone, tsunami and landslides

UNIT IV - SOCIAL ISSUES AND THE ENVIRONMENT

Sustainable development- Climate change: global warming, acid rain, ozone layer depletion and nuclear radiation- Environment Protection Act (any 2) air, water, wildlife and forest.

UNIT V - HUMAN POPULATION AND THE ENVIRONMENT

Population growth, variation among nations - Population explosion—Family Welfare Programme - Environment and human health - Human rights - Value education - HIV/AIDS - Women and Child Welfare - Role of Information Technology in environment and human health..

FIELD WORK

Students will visit any one of the following place of interest and submit a written report by the end of the semester:

1. Visit to a hospital/industry/canteen for solid waste management
2. Visit to a chemical industry to study about the practices followed there for waste disposal
3. Visit to Vandalur zoo for study of animal conservation/plants- flora and fauna
4. Study of simple ecosystems-lake/hill slopes
5. Naming the trees in the campus at SRM
6. Study of common plants, insects, birds in the neighbourhood
7. Study of common diseases and their prevention
8. Optional: Street plays and rally for awareness of obesity/diabetes/ vitamin D deficiency/health issues/ waste management/ solid waste management/ no plastics/ energy consumption/wild life protection.

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

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	20%	-	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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**
1. Mr. Suresh S, Program Head, Hello FM	*1. Dr. G Balasubramania Raja, Prof & Head, Manonmaniam Sundranar University* *Mail- gbs_raja@yahoo.com*	*1. Dr. Rajesh R, Head, SRM IST*
		2.Dr.S.Albert Antony Raj, Associate Professor and Head, SRMIST

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Course Code	UJK22301T	Course Name	*Universal Human Values*	Course Category	JK	*Life Skill Course*	L	T	P	C
							2	0	0	2

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning
CLR-1:	*To generate in students a sensitivity to current regional and national issues such as gender marginalization Eco sensitivity, vision for the Nation and general humanness*	Bloom's Level
CLR-2:	*An expanded consciousness with a mind to accommodate all is developed*	
CLR-3:	*The ability to accept all and to co- exist is initiated*	
CLR-4:	*To create community connectivity and interdependence*	
CLR-5:	*To instill intrinsic link between freedom and responsibility for both individuals and communities*	

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning
CLO-1:	Become sensitive toward every living life and be able to respect every religion recognizing the universal values	4
CLO-2:	Every way of life and culture will kindle the curiosity in them to know them and will be able appreciate the beauty in it	4
CLO-3:	*The presumptuous or prejudiced mentality will be overcome by them*	4
CLO-4:	Critical thinking and accommodative nature will become so natural way of thinking for them	4
CLO-5:	Will be able to explore their own emotions, hopes & fear and be able to describe them verbally	4

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
CLO-1:	*H*	-	-	-	-	-	-	-	-	-	*H*	-	-	-	-
CLO-2:	*H*	-	-	-	-	-	-	-	-	*H*	-	-	-	-	-
CLO-3:	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-4:	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5:	*H*	-	-	-	-	-	-	*H*	-	-	-	-	-	-	-

UNIT I

LOVE & COMPASSION

1. FORMS OF LOVE
2. DEFENITIONS FOR LOVE, COMPASSION, EMPATHY
3. DISCUSSION ON PERSONALITIES LIKE BEGAN, PAARI VENDHAR FROM SANGAM LITERATURE
4. LEE MOKOBE'S POEM 'ON BEING A TRANS'

TRUTH

1. THE VALUE OF TRUTH, UNIVERSAL TRUTH
2. MYTHOLOGY OF HARISHCHANDRAN
3. BACON'S ESSAY OF TRUTH
4. THE POWER OF TRUTH

The students will be introduced to Forms of love – for self, parents, family, friend, spouse, community, nation, humanity and other beings both for living and non-living. Definition for Love, compassion, empathy, sympathy and non-violence will be explained to the students through the texts. Universal truth, truth as value, truth as fact (veracity, sincerity, honesty among others will be introduced. Personalities and individuals from history for practicing compassion and love and truth and narratives and anecdotes from history, literature including local folklore will be discussed for the students to get better understanding of the concepts of Love and Compassion and Truth. What will one gain or lose by practicing or by not practicing these values will be instilled in the learners 'mind through discussions. The learners will be allowed a space to express their experience as an individual and in a group. Situations will be simulated in the class room for the students to get better understanding of Love and Compassion and Truth. Case studies will be discussed in the class room for learners to have a deeper understanding.

UNIT II

NON- VIOLENCE

1. MAHATMA GANDHI'S NON-VIOLENCE
2. D.H LAWRENCE' POEM SNAKE
3. ASHOK MITHRAN'S SHORT STORY – RAT
4. ANECDOTE FROM ANNIE BESANT AND ALBERT CAMU'S LIFE

RIGHTEIUSNESS

1. DISCUSS RIGHTEOUSNESS
2. DHARMA AND ARAM – THE DIFFERENCE
3. RAMA, LAKSHAMAN, RAVANA AND SURPANAKA- A DISCUSSION

4. SIX BLINDMEN AND AN ELEPHANT

The students will be introduced to Non-violence. Its need. Love, compassion, empathy sympathy for others as pre-requisites for non-violence will be explained through the given text. Ahimsa as Non-Violence and Non killing as a virtue is to be instilled in a learner. Righteousness and Dharma and its prioritization is to be discussed through the given text. Personalities and individuals from history for practicing Nonviolence and Righteousness is to be introduced and narratives and anecdotes from history, literature including local folklore will be discussed for the students to get better understanding of the concepts of Nonviolence and Righteousness. What will one gain or lose by practicing or by not practicing these values will be instilled in the learners' mind through discussions. The learners will be allowed a space to express their experience as an individual and in a group. Situations will be simulated in the class room for the students to get better understanding of Non-Violence and Righteousness. Case studies will be discussed in the class room for learners to have a deeper understanding.

UNIT III

PEACE

1. DEFINITION OF PEACE
2. HARMONY AND BALANCE WITH ORGANISATION AND SELF
3. MARTIN LUTHER KING'S I HAVE A DREAM
4. PROMETHEUS UNBOUND BY SHELLEY

SERVICE

1. MOTHER THERESA AND HER DARK LETTERS
2. LEE KUAN YEW' S LIFE STORY & NATURE OF DIFFERENT PROFESSIONS
3. THEMES OF TAGORE'S WHERE THE MIND IS WITHOUT FEAR
4. THEMES OF IF POEM BY KIPLING

The students will be introduced to what is peace and service. The need of peace, relation with harmony and balance and Individuals and organizations that are known for their commitment to peace will be discussed through the texts. What is service? Forms of service, for self, parents, family, friend, spouse, community, nation, humanity and other beings- living and non-living, persons in distress or disaster will be discussed through the texts. Peace and service as a virtue is to be instilled in a learner. Personalities and individuals from history for practicing Peace and service is to be introduced and narratives and anecdotes from history, literature including local folklore will be discussed for the students to get better understanding of the concepts of Peace and service. What will one gain or lose by practicing or by not practicing these values will be instilled in the learners' mind through discussions. The learners will be allowed a space to express their experience as an individual and in a group. Situations will be simulated in the class room for the students to get better understanding of Peace and service. Case studies will be discussed in the class room for learners to have a deeper understanding.

UNIT IV

RENUNCIATION

1. SELF- RESTRAIN, WAYS TO OVERCOME GREED, THE ART OF LETTING GO
2. BUDHA'S LIFE STORY
3. THE SHORT STORY OF ANTON CHECKOV- THE BET
4. RAMA THE SON AND BARATHA THE BROTHER AS EPITOMES OF RENUNCIATION

GRATITUDE

1. THE IDEA OF UNIVERSE TO TEACH HUMILITY AND GRATITUDE
2. THANKFULLNESS TO THE GIFT OF LIFE AND THE ABILTY TO COUNT ONE'S BLESSINGS
3. GRATEFUL TO EVERY LIFE TO MAKE OTHERS' LIFE EASIER
4. THEME OF THE POEM THE CRUTCHES BY BERTOLD BRECHT

The students will be introduced to Renunciation and gratitude. Self-restrain and ways of overcoming greed. Renunciation and gratitude with action as true renunciation and practice of gratitude as a virtue will be discussed through the texts. Personalities and individuals from history for practicing renunciation and possessing gratitude is to be introduced and narratives and anecdotes from history, literature including local folklore will be discussed for the students to get better understanding of the concepts. What will one gain or lose by practicing or by not practicing these values will be instilled in the learners' mind through discussions. The learners will be allowed a space to express their experience as an individual and in a group. Situations will be simulated in the class room for the students to get better understanding of renunciation and gratitude. Case studies will be discussed in the class room for learners to have a deeper understanding.

UNIT V

SCREENING OF MOVIES - THE WATER BY DEEPA MEHTA

THE TWO POPES BY FERNANDO MEIRELLES

ASSIGNMENT AND SEMINAR TO CHECK THE PERSONALITY OF THE LEARNER AND TO HAVE AN UNDERSTANDING OF HIS/HER ACQUIRED COGNIZANCE PERTAINING TO HUMAN VALUES.

Learning Resources	***Theory:*** Horizon- English Text Book – Compiled and Edited by the faculty of English Department, FSH, SRMIST, 2020

Learning Assessment

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

Level 6	Create	-	-	-	-	-	-	-	-
	Total	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 Higher Technical Institutions	Internal Experts
Prof. Daniel David, Prof & Head, Department of English, MCC, Chennai	Faculty Name, SRMIST
	Dr. Shanthichitra, Associate Professor, & Head, Department of English, FSH,SRMIST
	. Dr K B Geetha, Assistant Professor, Department of English, FSH, SRMIST

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SEMESTER IV

Course Code	UCY22401J	Course Name	Organic reaction mechanisms and Functional groups	Course Category	C	Core Course	L	T	P	C
							4	0	4	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:
CLR-1:	Gain knowledge on the importance of basic organic reaction mechanisms.
CLR-2:	Acquire knowledge about aromatic electrophilic and nucleophilic reactions.
CLR-3:	Strengthen their knowledge in addition reactions.
CLR-4:	Know about different functional groups and their reactivity.
CLR-5:	Acquire in-depth understanding about the carbonyl and carboxylic acid derivatives.

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
			Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	ICT Skills	Life Long Learning	PSO -1	PSO -2	PSO-3
CLO-1:	Understand aromatic electrophilic and nucleophilic reactions.	4	H	-	-	-	H	-	-	-	-	-	-	H	-	-	-
CLO-2:	Gain knowledge about the different types of addition reactions.	4	H	H	-	-	-	-	H	-	-	-	-	H	-	-	-
CLO-3:	Understand conformations of molecules and their applications.	4	H	-	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-4:	Know about the aromaticity and basic reaction mechanisms.	4	-	-	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-5:	Acquire in-depth understanding about the elimination and substitution reactions.	4	H	-	-	-	H	-	H	-	-	-	-	-	-	-	-

UNIT- I: Aromatic Electrophilic and Nucleophilic Reactions

Aromatic electrophilic substitution reaction: Friedel-Craft reaction: alkylation and acylation, advantages and disadvantages: like isomerization, poly alkylation; nitration, sulphonation (introduce KCP and TCP), halogenation, directing groups and product distribution when above mentioned reactions are performed.

Aromatic nucleophilic substitution reaction: mechanisms: via sigma complex, diazonium salt and benzyne intermediates, activated substrates, substrate scopes: presence of halogens, nuceophiles, scope of the diazonium salts in organic synthesis: transformation to halo, cyano, hydroxyl, hydrogen, fluoride, etc., preparation of azo-dyes.

PRACTICALS:

1. Introduce the lab and functional groups.
2. Detection of function groups like alcohol, phenol and amine.
3. Detection of function groups like carbonyl, ester and amide.

UNIT- II: Addition Reactions

Addition reaction: to carbon-carbon multiple bond; alkenes and alkynes; electrophilic addition; bromination; chlorination and iodination; stereochemistry of the addition reaction to double bond; reaction of halonium ions with other nucleophiles; like water; acetate; etc.. Addition to Conjugated double bonds; epoxidation. Nucleophilic addition reaction: conjugate addition; Free-Radical Addition; Cycloaddition reaction: Diels-Alder reaction.

PRACTICALS

1. Lassaigne's Test (sodium fusion test) and detect the elements like the element N in amines and nitro compounds.
2. Lassaigne's Test: detect the element S from thiophenols.
3. Lassaigne's Test: detect the halogens from aromatic halides.

UNIT- III: Functional Groups – Halides, Alcohols, Ethers and Epoxides

Functional groups: Halides: compare physical and chemical properties; synthesis using radical and substitution reactions; Grignard reagent; Gilman reagent of aliphatic and aromatic halides; alkali lithium compounds (pKa values). Alcohols: 1°, 2°, 3° alcohols; properties; synthesis using reduction reaction; addition reaction to carbonyl compounds; protection of alcohol; synthesis and reactions of diols. Introduce thiols and and their acidity and reactivity. Phenols: acidity and reactivity; Reimer–Tiemann reaction; Kolbe's–Schmidt Reactions; Vilsmeier–Haack reaction. Ethers: properties; synthesis: Williamson ether synthesis; synthesis and hydrolysis of t-butyl ethers. Epoxide: synthesis, opening in presence and absence of Lewis acid.

PRACTICALS:

1. Detect the functional group using Lassaigne's Test and followed by the diagnostic functional group test for alcohol, phenol, thiophenol.

2. Detect the functional group using Lassaigne's Test and followed by the diagnostic functional group test for carbonyl, carboxylic acid and ester.
3. Detect the functional group using Lassaigne's Test and followed by the diagnostic functional group test for nitro-compounds, amine, amide, and halo-arenes.

UNIT –IV: Functional Groups – Carbonyl Groups

Aldehyde and ketone: properties; polarization of carbonyl bond and its reactivity; synthesis using oxidation and reduction reactions; hydration; tautomerization; Schiff base formation and their stability; reduction of carbonyl group to alkane and alcohol; addition of Grignard and Gilman reagents; Aldol condensation; Cannizzaro; Benzoin condensation; Knoevenagel condensation; Claisen–Schmidt condensation; Mannich; Stork enamine; Wittig reaction and Horner-Wadsworth-Emmons Reaction.

PRACTICALS:

1. Separate organic compounds like acid, base and neutral using an acid-base treatment.
2. Separate the compound and carry forward one functional group test using Lassaigne's test followed by the diagnostic functional group test for carbonyl compounds and carboxylic acids.
3. Separate the compound and carry forward one functional group test using Lassaigne's test followed by the diagnostic functional group test for alcohols and phenols.

UNIT - V: Functional Groups - Carboxylic acid and its derivatives

Carboxylic acid: properties; synthesis; acid chloride; saturated and unsaturated acids. Eater and Amide: synthesis using acid chloride; DCC coupling; trans esterification; hydrolysis under acid and basic medium and mechanisms; proof for the mechanisms: AAC2; BAC2; lactones and lactums and their synthesis; Claisen condensation; Dieckmann reactions; Reformatsky reactions; acyloin reaction. Active methylene compounds: introduce different substituents; acidity and synthesis; addition to conjugated alkenes; uses in synthesis of cycloalkanes; Robinson annulation; decarboxylation of □-keto acid; Acid anhydride: synthesis and reactivity.

PRACTICALS:

1. Separate the compound and carry forward one functional group test using Lassaigne's test followed by the diagnostic functional group test for amines and nitro-compounds.
2. Separate the compound and carry forward one functional group test using Lassaigne's test followed by the diagnostic functional group test for amides.
3.Separate the compound and carry forward one functional group test using Lassaigne's test followed by the diagnostic functional group test for halides..

Learning Resources	**Theory:** 1. M. B. Smith and J. March, March's Advance Organic Chemistry, 6th Ed., John Wiley and Sons, Inc. 2. J. Clayden, N. Greeves, and S. Warren, Organic Chemistry 2nd Ed., Oxford. 3. J. McMurry, Organic Chemistry 5th Ed., Thomson. 4. T. W. G. Solomons and C. B. Fryhle, Organic Chemistry 10th Ed., John Wiley and Sons, Inc. 5. I. L. Finar and A. L. Finar, Organic Chemistry Vol. 2, Addison-Wesley.	**Practicals:** 1. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson, 2012 2. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and QuantitativeAnalysis, University Press, 2000. 3. Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, UniversityPress 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	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Level 2	Understand	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Level 3	Apply	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Level 4	Analyze	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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	Dr. S. Pramanik, SRMIST
	Dr. Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru Email: kanishka@jncasr.ac.in	Prof. M. Arthanareeswari, SRMIST

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Course Code	UCY22402T	Course Name	Main Group Elements and Nuclear Chemistry	Course Category	C	Core course	L	T	P	C
							4	0	0	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:	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
			Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	ICT Skills	Life Long Learning	PSO -1	PSO -2	PSO-3
CLO-1 :	Perceive the importance of periodicity of the s-block elements	4	H	H	H	-	-	-	-	-	-	-	-	-	H	-	-
CLO-2 :	Understand the chemical properties of alkali and alkaline earth metals	4	H	H	-	H		-	-	-	-	-	-	-	H	-	-
CLO-3 :	Gaining the knowledge about hydrides, oxides and oxoacids of p-block elements	4	-	-	-	H	-	-	-	-	-	-	-	-	H	-	-
CLO-4 :	Design and develop industrially valuable p-block element compounds	4	H	H	-	-	-	-	-	-	-	-	-	-	H	M	-
CLO-5 :	Interpret the role of radioactivity in power generation, medicine and archaeology	4	-	H	H	-	-	-	-	-	-	-	-	-	H	H-	-

Unit I: s- block elements: Alkali metals

Electronic configuration of s-block elements, Trend of atomic size, ionization energy, density, reducing power, melting and boiling points and Flame colour of alkali metals, Reaction of alkali metals with H2, O2, N2, water and liq.NH3, Trend of thermal stability of hydrides, oxides, peroxides and superoxides, anomalous behaviour of Li, diagonal relationship of Li with Mg, Important alkali metal compounds:Coordination complexes of Li, Crown ethers, cryptates, biological importance of alkali metals

Unit II: s-block elements: Alkali earth metals

General properties and trend of periodic properties of alkaline earth metals, Chemical properties: Formation of hydrides, oxides, carbides and salts, Relationship between lattice energy, hydration and solubility, Trend of thermal stability and solubility of hydrides, oxides, hydroxides, sulphates, nitrates, carbonates and halides of alkaline earth metals, Important alkaline earth metal compounds: basic beryllium acetate, beryllium nitrate, EDTA complexes of calcium and Magnesium.

Unit III: General Characteristics of p-block elements

General properties of p-block elements, Allotropes of C, P and S, Inert pair effect, Catenation, anomalous behaviour of Boron, Diagonal relationship between B and Si, Hydrides of p-block elements- thermal stability, reducing power, acidic/basic strength, Acidic/Basic Character of p-block element oxides, preparation and properties of oxides of N and P, preparation and properties of oxoacids of P, S and halogens- Structure, oxidation state and basicity.

Unit IV: Important p-block element compounds

Classification of boranes, Wade's rule to predict the cluster structure of boranes, STYX code, Structure and bonding of diborane, preparation and uses of borazine - similarities in structure with benzene, Structure of silicates, Preparation, properties and structure of silicones, halides of silicon, halides of phosphorus, Phosphonitrilic halides, Interhalogen compounds, pseudohalogen compounds, Clathrate compounds of noble gases, xenon fluorides. MOT approach of bonding in XeF2.

Unit V: Nuclear Chemistry

Composition of nucleus and nuclear forces, nuclear stability, mass defect, binding energy, packing fraction, n/p ratio, magic numbers, nuclear models - liquid drop and shell model, Isotopes, isobars, and isotones and nuclear isomers. Radioactivity – natural and artificial radioactivity; types of radioactive decay, law of radioactive deacy - rate of disintegration - half life and average life, Measurement of radioactivity, Nuclear fission and Nuclear fusion reaction, Applications of radioactive decay: carbon dating, neutron activation analysis, isotopic labeling, and nuclear medicine..

Learning Resources

References:

1. Lee, J.D., Concise Inorganic Chemistry, Fifth Edn., Wiley India.
2. Huheey, J.E., Keiter, E.A., Keiter, R. L., Medhi, O.K., Inorganic Chemistry- Principles of Structure and Reactivity, Pearson Edu. 2009.
3. Douglas, B.E., McDaniel, D.H., Alexander, J.J., 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,©2010, W. H. Freeman and Company, 41 Madison Avenue, New York, NY 10010, www.whfreeman.com.

	5. Miessler, Gary L., Fischer Paul J., Tarr, Donald A., Inorganic Chemistry, Fifth edition, Pearson, 2014.2. 6. Textbook of Inorganic Chemistry, P.l. Soni, Mohan Katyal,Sultan Chand & Sons Publishers. 7. Satyaprakash, G.D. Tuli, S. K. Basu, R.D. Madan, Advanced Inorganic Chemistry – I, Sultan Chand & Sons Publishers. 8. Sharon Maheshwar, Nuclear Chemistry, Second edition, Taylor & Francis Publishers.

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	20%	-	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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	*1. Prof. G. Sekar, IIT Madras, gsekar@iitm.ac.in*	1. Prof. Dr. M. Arthanareeswari, SRM IST
	2. Prof. Vivek Polshettiwar, TIFR Mumbai, vivekpol@tifr.res.in	*2. Dr. M. Ganesh Pandian, SRM IST*

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Course Code	UCY22403T	Course Name	Quantum Chemistry and Group theory	Course Category	C	Core Course	L	T	P	C
							4	*0*	*0*	*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 about basic concepts of Group theory in chemistry	
CLR-5	*Understand the application of Group theory in 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 Disciplinary Knowledge	2 Critical Thinking	3 Problem Solving	4 Analytical Reasoning	5 Research Skills	6 Team Work	7 Scientific Reasoning	8 Reflective Thinking	9 Self-Directed Learning	10 Multicultural Competence	11 ICT Skills	12 Life Long Learning	13 PSO -1	14 PSO -2	15 PSO-3
CLO-1	*State laws of distribution and determine the distribution and partition coefficient*	*4*	*H*	*H*	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-2	*Solve Schrodinger wave equation for 1D,3D and SHO system*	*4*	*H*	-	*H*	-	-	-	*M*	-	-	-	-	-	-	-	-
CLO-3	*Solve Schrodinger wave equation for Rigid rotator, Hydrogen atom*	*4*	*H*	-	*H*	-	-	-	*M*	-	-	-	-	-	-	-	-
CLO-4	*Predict the possible symmetry elements in molecules and construct character table*	*4*	*H*	*H*	-	-	*M*	-	-	-	-	-	-	-	-	-	-
CLO-5	Apply the Group theory concepts in spectroscopy and chemical bonding	*4*	-	*H*	*H*	-	*M*	-	-	-	-	-	-	-	-	-	-

UNIT I Basics of Quantum Mechanics

de-Broglie 's concept, experimental verification- Compton effect - Heisenberg 's uncertainty principle – derivation of Schrodinger wave equation - requirements of the acceptable wave function. Operators, linear operators, method of getting the following quantum mechanical operators: Position, Momentum, kinetic energy, potential energy, total energy, angular momentum. Hermicity and proving the quantum mechanical operators are Hermitian operation- commutator algebra-evaluation of commutators - eigen functions and eigen values - postulates of quantum mechanics.

UNIT II Applications of Quantum Mechanics-I

Particle in a one-dimensional box - quantisation of energy - normalisation of wave function - orthogonality of the particle in a one-dimensional box wave functions - average position and average momentum of a particle in a one-dimensional box - illustration of the uncertainty principle and correspondence principle with reference to the particle in a one-dimensional box.

Schrodinger wave equation for a particle in a three-dimensional box and the concept of degeneracy of energy levels. Schrodinger wave equation for linear harmonic oscillator, solution by polynomial method, zero-point energy and its consequence.

UNIT III Applications of Quantum Mechanics-II

Solving of Schrodinger wave equation for Rigid rotator, energy of rigid rotator, Schrodinger wave equation for hydrogen atom, separation of variable in polar spherical coordinates and its solution, principal, azimuthal and magnetic quantum numbers and the magnitude of their values, probability distribution function, radial distribution function and shape of atomic orbitals (s, p & d).

UNIT IV Basics of Group Theory

Symmetry elements and symmetry operations, group and its properties, Multiplication table, point symmetry groups. Schoenflies symbol, representations of groups by matrices, Irreducible representation of groups, the Great Orthogonality theorem, construction of character table (C_{2V}, C_{3v} only).

UNIT V Applications of Group theory

Applications of group theory to normal modes analysis, Selection rules for fundamental vibrational transition – IR and Raman activity of fundamentals in H_2O, BF_3, CO_2 – The rule of mutual exclusion. Application to bonding theory – hybridization (AB_3, AB_4).

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. D.A. Mcquarrie, Quantum Chemistry, University Science Books, 1983. 4. Ira.N. Levine, Quantum Chemistry,7th edition, Allyn and Bacon, 1983. 5. P. W. Atkins, J. De Paula, Physical Chemistry, 9thEd., Oxford University Press, Oxford, 2010 **6.** Cotton F. A, Chemical applications of group theory, 3rd edition, John Wiley& Sons, 2004 **7.** G.Davidson, Introduction to Group Theory for Chemist, Applied Science Publishers Ltd., London (1971). **8.** K.V.Raman, Group Theory and its Application in Chemistry, Tata McGrew-Hill, (1990). **9.** V.Ramakrishnan and Gopinath, Group Theory in Chemistry, 2nd edn., Vishal Publications, 1991.

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	20%	-	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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	Prof. M. Arthanareeswari, SRMIST
	Dr. Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru Email: kanishka@jncasr.ac.in	Dr. J. Arockia Selvi, SRMIST

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Course Code	UCY22D01T	Course Name	Introduction to nanochemistry and applications	Course Category	D	Discipline Specific Elective	L	T	P	C
							3	0	0	3

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 both fundamentals and broad knowledge about nanochemistry	
CLR-2:	To learn and understand about characteristic of nanomaterials	
CLR-3:	To learn about nanomaterials synthetic techniques	
CLR-4:	Acquire knowledge about nanomaterials and their diverse applications	
CLR-5:	To learn about nanomaterials for real time energy and environmental 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
			Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	ICT Skills	Life Long Learning	PSO -1	PSO -2	PSO-3
CLO-1:	Understand the basics of nanochemistry and nanomaterials	4	M	-	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-2:	Gain knowledge about characteristics of structured nanomaterials and nanocatalysts	4	H	-	-	M	-	-	-	-	-	-	-	-	-	-	-
CLO-3:	Understand about the various nanomaterial's synthetic technique's and identify suitable methods for specific nanomaterial synthesis	4	H	M	-	-	M	-	-	-	-	-	-	-	-	-	-
CLO-4:	Apply the nanomaterials for wide range of energy and environmental and healthcare applications	4	-	M	H	H	-	-	-	-	-	-	-	-	-	-	-
CLO-5:	Apply nanomaterials and nanocatalysts for sustainable energy and environmental applications, including Solar Energy and Photovoltaics	4	-	H	H	-	-	-	-	-	-	-	-	-	-	-	-

UNIT- I: Introduction to Nanochemistry and Nanomaterials

Historical Development, an overview for nanochemistry, nanotechnologies and their importance, Classification of nanomaterials, Definition of Nano - Fundamentals of Nanochemistry-Nanomaterial –Nanochemistry in nature, discussion on various phenomenon at nanoscale materials, influence of nano morphologies and micro/macro, nanosizes on the properties. Opportunities and challenges on nanomaterials.

UNIT-II: Characteristic of nanomaterials

Characteristic of nanomaterials such as physical-chemical, optical, electronic, conducting, semiconducting, magnetic, mechanical properties. In addition to that how size, shape, types of dimensional (1D,2D, and 3D), quantum dots, core-shell affects/impact on the nanomaterial's properties.

UNIT- III: Nanomaterials synthetic techniques

Nanostructured materials synthesis methods– top-down and bottom-up, solvothermal, hydrothermal, calcination, sol gel method- template assisted-non template assisted, self-assemble, electrodeposition, Spin coating, Chemical Vapour Deposition (CVD), grinding - high energy ball milling.

UNIT- IV: Nanomaterials and their potential applications

Electronics, nanoelectronics, computer science, engineering, materials science, ferroelectric materials, medicinal application, drug delivery, healthcare products, earth science, membranes, ceramic membranes, environmental applications, including water purification, virus elimination.

UNIT-V: Nanomaterials for energy and environmental applications

Recent developed nanomaterials (organic-inorganic hybrid nanocatalysts) for Sustainable Energy-Solar Energy Conversion, Solar cells, Dye-sensitized solar cells, Photovoltaics, Water splitting into H2, CO2 in to solar fuels, biomass into solar fuels, water depollution, Current status and future prospects..

Learning Resources

References:

1. C. N. R. Rao, A. Muller and A. K. Cheetam, (Eds) The Chemistry of Nanomaterials, Vol.1, and 2, Wiley – VCH, Weinheim, 2004.
2. Roco, M. C. "Nanoparticles and nanotechnology research." Journal of Nanoparticle Research 1.1 (1999): 1.
3. C. P. Poole, and Jr. F. J. Owens, Introduction to Nanotechnology, Wiley Interscience, New Jersey. 2003.
4. T. Pradeep, Nano: The Essentials in Understanding Nanoscience and Nanotechnology, Tata McGraw Hill, New Delhi, 2007.
5. U. Heiz, and U. Landman, Nanocatalysis, Springer, New York, 2006.

	6. T. Tang and P. Sheng, Nano Science and Technology – Novel Structures and Phenomena,Taylor & Francis, New York, 2004.

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	20%	-	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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	Prof. M. Arthanareeswari, SRMIST
	Dr. Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru Email: kanishka@jncasr.ac.in	Dr. Karthikeyan Sekar, SRMIST

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Course Code	UCY22D02T	Course Name	Energy and fuel cells	Course Category	D	Discipline Specific Elective	L	T	P	C
							3	0	0	3

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:	Know about the forms and resources of energy
CLR-2:	Educate students on the present Indian energy scenario
CLR-3:	Gain knowledge about solar energy
CLR-4:	Learn concept and operation of available and relevant energy storage systems
CLR-5:	Know about the chemistry of fuels

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
			Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	ICT Skills	Life Long Learning	PSO -1	PSO -2	PSO-3
CLO-1:	Understand the importance of energy conservation	4	-	-	-	-	-	-	-	-	H	-	-	H	-	-	-
CLO-2:	Know the need for new renewable energy resources	4	H	-	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-3:	Acquire knowledge about the solar cells	4	H	-	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-4:	Identify available technologies and materials for energy storage and their application areas	4	-	-	H	-	-	-	H	-	-	-	-	-	-	-	-
CLO-5:	Create a fuel cell based energy storage system	4	-	-	H	-	H	-	-	-	H	-	-	-	-	-	-

UNIT- I: Introduction to Energy

Definition and units of energy- power- forms of energy- conservation of energy- second law of thermodynamics- energy flow diagram to the earth. Origin of non-renewable energy source-fossil fuels- time scale of fossil fuels- renewable energy resources- role of energy in economic development and social transformation.

UNIT- II: Indian Energy Scenario

Commercial and non-commercial forms of energy- energy consumption pattern and its variation as a function of time- energy resources available in India- urban and rural energy consumption- nuclear energy - promise and future- energy as a factor limiting growth-need for use of new and renewable energy sources.

UNIT-III: Solar Energy

Definition- energy available from sun- solar radiation data- solar energy conversion into heat and electricity- principle of natural and forced convection- photo voltaics- p-n junctions. Solar cells- types of solar cells. Basic ideas of electro and photo catalytic water splitting

UNIT- IV: Energy Storage Devices

Electrochemical energy storage devices - Battery - Primary Batteries - Secondary Batteries - Lithium Batteries, Solid state Batteries - Lead Acid Batteries - Nickel cadmium Batteries, Super capacitor - Electrochemical double layer capacitor (EDLC).

UNIT- V: Fuel Cell Technology

Introduction and overview of fuel cell technology-difference between batteries and fuel cells- fuel cell principle- components of fuel cells- classification by operating temperature / electrolyte types-mechanism and applications of solid oxide fuel cells- molten carbonate fuel cells- alkaline fuel cells- polymer electrolyte membrane fuel cells- direct methanol fuel cells.

Learning Resources

Theory:

1. Jose Goldenberg, Thomas B. Johansson, Amulya K.N. Reddy and Robert H. Williams, *Energy for Development*, Washington D.C., World Resource Institute, 1985.
2. Charles E. Brown, *World Energy Resources*, Springer, 2002
3. Hoogers, *Fuel cell technology*, Handbook, CRC Press, 2003.
4. H. Liu, *Principles of Fuel Cells*, Taylor & Francis, N.Y, 2006.
5. R. Foster, M. Ghassemi, A. Cota, *Solar Energy*, CRC Press, 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	20%	-	20%	-	20%	-	20%	-	20%	-

Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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	Prof. M. Arthanareeswari, SRMIST
	Dr. Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru Email: kanishka@jncasr.ac.in	Dr. T. Pushpa Malini, SRMIST

Course Code	UCY22S02T	Course Name	Industrial Skills	Course Category	S	Skill Enhancement Course	L	T	P	C
							2	0	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:
CLR-1:	Educate issues pertaining to the safety, hazard and enviromental aspects
CLR-2:	Acquire both fundamentals and broad knowledge of work culture in chemical industries
CLR-3:	Learn about skills required for the small and large scale productions in chemical chemistries
CLR-4:	Gain knowledge about purification and characterization techniques involved in small and bulk scale products
CLR-5:	Teach the students to learn the quality control, quality assurance protocols and supply chain management.

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 Disciplinary Knowledge	2 Critical Thinking	3 Problem Solving	4 Analytical Reasoning	5 Research Skills	6 Team Work	7 Scientific Reasoning	8 Reflective Thinking	9 Self-Directed Learning	10 Multicultural Competence	11 ICT Skills	12 Life Long Learning	13 PSO -1	14 PSO -2	15 PSO-3
CLO-1:	Apply the different safety measures to protect the health and environment	4	H	-	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-2:	Learn the systematic approach in drug discovery and development in pharamaceutical industry	4	H	-	-	-	-	-	M	-	-	-	-	-	-	-	-
CLO-3:	Develop the skills for small and large scale set up in industries	4	H	-	-	-	M	-	-	-	-	-	-	-	-	-	-
CLO-4:	Perform the various types of purification methods and different characterization techniques	4	-	-	M	H	-	-	-	-	-	-	-	-	-	-	-
CLO-5:	Understand the different types of quality control, quality assurance protocols and supply chain management followed in industries	4	-	-	-	-	H	H	-	-	H	-	-	-	-	-	-

UNIT-I: Laboratory safety for chemistry students- general introduction; Prudent practices in the laboratory; Personal protective equipment for chemical, biological, and radiological hazards: design, evaluation, and selection; Effluent treatment process for wastages.

UNIT-II: General expertise required for the drug development process: Target identification, Target validation, lead identification, lead optimization, Formulation and development, Preclinical research (brief introduction), Investigational New Drug, Clinical trials (brief introduction), New Drug Application and Approval

UNIT- III: Process involving in small scale and large scale set up: small scale: High throughput screening, Combinatorial synthesis (Parallel synthesizer) and Quality by Design (QbD); Large scale: Conventional hydrogenation using autoclave, BuLi reactions and Grignard reactions, Importance of various types of reactors E.g Glass reactor and stainless-steel reactors.

UNIT-IV:
Different types of distillation, Crystallization and seeding techniques, Column chromatography and Dry solvent prepartions; Different characterization techniques: Online reaction monitoring process (NMR, IR and HPLC), Real-time gas analysis and reaction monitoring using mass spectrometry, Thin layer chromatography (TLC) and preparative TLC, Loss on drying and Moisture content checking.

UNIT-V: Quality control: Component of QC, Specifications, Batch inspection and sampling, Validation, Analysis of finished products; Quality assurance: Good manufacturing practices (GMP), Good laboratory practices (GLP), Batch manufacturing report (BMR), technology transfer, Documentation; Procurement and SCM.

Learning Resources

Theory:

1. Hill, Robert H., Finster, David C., 2010. Laboratory Safety for Chemistry Students. John Wiley and Sons Inc, New Jersey.
2. Patrick, G. L. An Introduction to Medicinal Chemistry, 5th ed.; Oxford University Press: Oxford, U.K., 2013.
3. W.L.F. Armarego, Purification of Laboratory Chemicals, Part 1 Physical Techniques, Chemical Techniques, Organic Chemicals, 9th Edition - August 1, 2022.
4. Mrs G. Sai Sri Lakshami, Dr. T. Vinay Kumar, Dr. K. Shanta Kumari. Concepts of Pharmaceutical Quality Assurance and Quality Management, 2019, K.S.K. Publishers

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	20%	-	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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	Dr. Baskar Baburaj, SRMIST
	Dr. Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru Email: kanishka@jncasr.ac.in	Dr. Gopal Chandru Senadi, SRMIST

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Course Code	UJK22401T	Course Name	Professional Skills	Course Category	JK	Life Skill Course	L	T	P	C
							2	0	0	2

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	expose students to the requirements of job market
CLR-2:	develop resume building practice
CLR-3:	increase efficiency in speaking during group discussions
CLR-4:	prepare students for job interviews
CLR-5:	instil confidence in students and develop skills necessary to face audience
CLR-6:	develop speaking and presentation skills in students

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning Bloom's Level	Program Learning Outcomes (PLO)													
			1 Disciplinary Knowledge	2 Critical Thinking	3 Problem Solving	4 Analytical Reasoning	5 Research Skills	6 Team Work	7 Scientific Reasoning	8 Reflective Thinking	9 Self-Directed Learning	10 Multicultural Competence	11 Ethical Reasoning	12 Community Engagement	13 ICT Skills	14 Leadership Skills	15 Life Long Learning
CLO-1:	understand the importance of resume preparation and build resume	4	M	-	-	-	-	-	-	M	-	-	-	-	H	M	H
CLO-2:	acquire group discussion skills	4	M	-	M	-	-	H	-	M	-	H	-	-	L	H	H
CLO-3:	face interviews confidently	4	M	-	M	-	-	L	-	M	-	H	-	-	M	H	H
CLO-4:	Ask appropriate questions during an interview	4	M	-	M	-	-	L	-	M	-	M	-	-	M	H	H
CLO-5:	understand various types of presentation and use presentation skills in projects	4	M	-	M	-	-	H	-	M	-	M	-	-	H	M	H
CLO-6 :	build confidence during any presentation	4	M	-	M	-	-	M	-	M	-	-	-	-	M	H	H

Unit-1: Introduction of resume and its importance, Difference between a CV, Resume and Bio Data, Essential components of a good resume, common errors people make while preparing a resume, Resume building format, Resume building using templates, Resume building activity, Resume building activity – Feedback, Video resume – Tips and tricks, Video resume – Do's and Don'ts, Video resume – Templates

Unit-2: Meaning and methods of group discussion, Procedure of group discussion, Group discussion – simulation, Group discussion – common errors, Group discussion – types – Topic based, Group discussion – types – Case study based, Group discussion – practice session- Topic based, Group discussion – Feedback, Group discussion – practice session- Topic based, Group discussion – Feedback, Group discussion – practice session- Case study based, Group discussion – Feedback

Unit-3: Meaning and types of interview (face to face, telephonic, video), Dress code, background research, STAR Technique (situation, task, approach and response) for facing an interview, Interview procedure (opening, listening skills, closure, asking questions), Important questions generally asked in an interview, Mock interview – face to face, Mock interview- Feedback

Unit-4: Types - Informative, Instructional, Arousing, Persuasive, Decision-making, Structure of a presentation – Introduction of the event, Introducing the speaker, vote of thanks, Working with audience – ice-breaking, Creating a 'Plan B', Getting the audience in the mood, working with emotions, Improvisation and unprepared presentations, man-woman view, feedback – appreciation and critique, Power point presentation, skit, drama, dance, mime, short films and documentary – Dos and Don'ts, PowerPoint presentation–logical arrangement of content, PowerPoint presentation–using internet source, citations, bibliography

Unit-5: PowerPoint presentation–body language and stage etiquettes, PowerPoint presentation–practice session

Learning Resources

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

Learning Assessment									
	Bloom's Level of Thinking	Continuous Learning Assessment (100% weightage)							
		CLA – 1 (20%)		CLA – 2 (20%)		CLA – 3 (30%)		CLA – 4 (30%)#	
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-
Level 6	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
1. Ajay Zener, Director, Career Launcher	-	*1. Mr Priyanand, Assistant Professor, CDC, E&T, SRMIST* *2. Ms Sindhu Thomas, Head in charge, CDC, FSH, SRMIST* *3. Ms Mahalakshmi, Assistant Professor, CDC, FSH, SRMIST*

Course Code	*UMI22S01L*	Course Name	My India Project	Course Category	*P*	Internship/ Project/ Community Outreach	L	T	P	C
							0	0	0	1

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%	

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SEMESTER V

Course Code	UCY22501J	Course Name	Coordination Chemistry	Course Category	C	Core course	L	T	P	C
							4	0	4	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:	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	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	ICT Skills	Life Long Learning	PSO -1	PSO -2	PSO-3
CLO-1:	Understand the basic terms and use standard rules to name coordination compounds	4	H	-	-	H	-	-	-	-	-	-	-	-	H	-	-
CLO-2:	Discuss the various types of isomerism possible in in a metal complex.	4	H	H	-	H	-	-	-	-	-	-	-	-	H	-	-
CLO-3:	Correlate the gradational development of theories of coordination complexes due to splitting of orbitals.	4	-	H	-	-	-	-	-	-	-	-	-	-	-	H	-
CLO-4:	Gaining the knowledge of magnetic properties and colour of complexes	4	H	-	-	H	H	-	-	-	-	-	-	-	H	-	-
CLO-5:	Realize the important properties of transition metals and use Latimer diagrams to predict and identify different types species	4	-	H	H	-	-	-	-	-	-	-	-	-	-	H	M

Unit – I: Introduction of Coordination Chemistry

Addition or molecular compounds-double salts and coordination compounds, complex ions, Ligands- monodentate, bidentate, and polydentate ligands, coordination sphere, coordination number, ambidentate ligands, bridging ligands and bridged complexes, flexidentate ligands, tendency of polydentate ligands to form chelates, chelation, chelate effect, applications of chelate formation, formation of metal-metal bond in dimers, nomenclature of coordination compounds, Werner‘s coordination theory-Salient features, designation and formation of Co(III) ammines on the basis of Werner‘s coordination theory and experimental verifications, limitations of Werner’s theory, Sidgwick’s electronic concepts of coordination bond in coordination compounds, Sidgwick’s effective atomic number (EAN) rule and application of EAN rule, limitations of Sidgwick’s concept, Isomerism in coordination compounds, structural isomerism-conformation, linkage, ionization, hydrate, ligand, coordination, coordination position and polymerization isomerisms, stereoisomerism: geometrical and optical isomerisms-4 and 6 coordinate complexes.

Unit – II: Stability of Coordination Complexes

Stability of complexes: Thermodynamic stability-stable and unstable complexes and kinetic stability-labile and inert complexes, stepwise and overall formation of complexes-stepwise and overall stability constant, relation between stepwise and overall stability constant, factors affecting stability of coordination compounds-properties of metal ions, properties of the ligands and stability of chelates, steric effects and electron delocalization, methods for the determination of stability constants and composition of a complex-spectrophotometric method, continuous variation method (Job's method), Bjerrum’s method, Irving and Rossotti method, limitations.

Unit – III: Theory of Coordination Complexes

Valence bond theory (VBT): Assumptions, VBT as applied to octahedral, tetrahedral and square planer complexes, mMagnetism and drawbacks of VBT. Crystal field theory (CFT): salient features of CFT, crystal field splitting of d-orbitals in tetrahedral, octahedral, tetragonal and square planar complexes, factors influencing the magnitude of CFT, crystal field stabilization energy (CFSE) of dx ions, high-spin and low-spin complexes, applications of CFT-colour in coordination compounds and magnetic moment values of complex, limitations of CFT, Jahn-Teller theorem-crystal field splitting in tetragonally distorted octahedral geometry and in square planar geometry, octahedral versus tetrahedral coordinations-spinels,

MO Theory: metal orbitals and LGOs suitable for σ and π bonding in octahedral geometry, construction of qualitative MO energy level diagram for bonding in octahedral geometry.

Unit – IV: Reaction mechanisms in coordination compounds-I

Labile and inert complexes on the basis of valence bond theory, ligand substitution reactions in octahedral complexes, dissociation, association and interchange mechanisms, Reaction profile of dissociative and association mechanisms, factors affecting rates of substitution reactions. mechanism of hydrolysis reactions, acid hydrolysis-octahedral complexes with π-donor inert ligand, π-acceptor inert ligand and without π-donor and π-acceptor inert

ligand, experimental tests of mechanisms and stereochemistry, base hydrolysis-associative SN2 and dissociative SN1CB mechanisms, stereochemistry, racemization reaction, anation reactions, ligand substitution reactions square planar complexes, dissociation, association and interchange mechanisms, nucleophilicity of the entering groups, trans effect, trans influence, trans effect and its application, theories of trans effect-polarization and π-bonding theory.

Unit – V: Reaction mechanisms in coordination compounds-II

Electron transfer reactions, one electron transfer reactions, inner sphere mechanism, outer sphere mechanism, Marcustheory and its applications, two electron transfer reactions, complementary and non-complementary electron transfer reactions, molecular rearrangements-four-coordinate and six-coordinate complexes. synthesis of coordination compounds using electron transfer reactions, metal assisted reactions, aldol condensation, ester hydrolysis, phosphate ester, aminoesters and amide hydrolysis, template effect, synthesis of macrocyclic ligands, reaction of coordinated ligands.

Practicals:

Semi Micro Qualitative Analysis:

Qualitative analysis of a mixture containing two anions and two cations. Analysis of a mixture containing two cations and two anions of which one will be an interfering ion.

Anions: Carbonate, sulphate, chloride, nitrate, borate, chromate, oxalate, tartrate, phosphate and etc

Cations: Lead, bismuth, copper, cadmium, antimony, iron, zinc, cobalt, nickel, manganese, calcium, strontium, barium, ammonium and etc

Preparation of Inorganic compounds:

1. Preparation of Prussian Blue
2. Preparation of Tetrammine Copper(II) sulphate tetrahydrate
3. Preparation of Tristhiourea copper(II) sulphate dihydrate
4. Preparation of Potassium trioxalato ferrte (II).
5. Preparation of Copper(II) chloride.
6. Determination of Cr(III) complexes. [Cr(H2O)6]NO3.3H2O and [Cr(H2O)4Cl2]Cl.2H2O
7. Preparation of (N,N)- bis(salicyldehyde)ethylenedi amine Salen H2; and its cobalt complex [Co(Salen)].
8. Preparation of [Cr(en)3]Cl3 and [Cr(acac)3].

Learning Resources	**Theory:** 1. Atkins, P.,Overton, T. Shriver and Atkins' inorganic chemistry 6th Ed. Oxford University Press, USA, 2010. 2. Pfennig, B. W. Principles of Inorganic chemistry. John Wiley & Sons, 2015. 3. Purcell, K.F & Kotz, J.C., Inorganic Chemistry W.B. Saunders Co, 1977. 4. Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993. 5. Cotton, F.A. & Wilkinson, G., Advanced Inorganic Chemistry Wiley-VCH, 1999. 6. Basolo, F, and Pearson, R.C., Mechanisms of Inorganic Chemistry, John Wiley & Sons, NY, 1967. 7. Greenwood, N.N. & Earnshaw A., Chemistry of the Elements, Butterworth-Heinemann, 1997. 8. Miessler, G. L. &. Tarr, Donald A. Inorganic Chemistry 3rd Ed.(adapted), Pearson, 2009 9. Barnes, C. E. Inorganic Chemistry 4th Ed. (Catherine E. Housecroft and Alan G. Sharpe). Journal of Chemical Education, 2003.	**Practicals:** 1. Vogel, A.I. A text book of Quantitative Analysis, ELBS 1986. 2. G. Marr and B.W. Rockett, Practical Inorganic Chemistry

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	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Level 2	Understand	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Level 3	Apply	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Level 4	Analyze	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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. S. Shanmugan, SRMIST
	Dr. Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru Email: kanishka@jncasr.ac.in	Prof. M. Arthanareeswari, SRMIST

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Course Code	UCY22502T	Course Name	Functional groups, heterocycles, polyaromatics and pericyclic reactions	Course Category	C	Core Course	L	T	P	C
							4	0	0	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 knowledge on the nitrogen-containing functional groups.
CLR-2:	Enable the students to acquire knowledge about the heterocycles.
CLR-3:	Gain the in depth knowledge about heterocyclic chemistry.
CLR-4:	Acquire knowledge in the fundamentals of pericyclic reaction.
CLR-5:	Enable students to understand chemistry of polyaromatic 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
			Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	ICT Skills	Life Long Learning	PSO -1	PSO -2	PSO-3
CLO-1:	Understand the basic concepts of nitrogen-containing functional groups.	4	H	-	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-2:	Gain knowledge in the synthesis of heterocycles.	4	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-3:	Acquaint the concepts of substitution reactions in heterocyclic compounds.	4	H	H	-	-	M	-	-	-	-	-	-	-	-	-	-
CLO-4:	Apply the concepts of aromaticity in understanding reactions in polyaromatic reactions	4	-	-	H	H	-	-	-	-	-	-	-	-	-	-	-
CLO-5:	Gain knowledge about the pericyclic reaction.	4	H		-	H	-	-	H	-	-	-	-	-	-	-	-

UNIT- I: Nitrogen containing functional groups

Amines: aliphatic and aromatic amines, their basicity and reactivity, synthesis using reduction of nitro- and nitrile compounds, Gabriel synthesis, use of phthalimide in organic synthesis, distinction of primary, secondary and tertiary amines using Hinsberg's method and nitrous acid method.

Nitro compounds: properties, synthesis using oxidation reactions, Henry reaction, Reduction in basic, acidic and neutral medium (for aromatic compounds); Reduction- electrolytic reduction,

Nitriles: Introduction, Nomenclature and uses; Preparation from the dehydration of amides and aldoximes; From Grignard reagents and from dehydrogenation of primary amines; Preparation using substitution reaction in alkyl halides and tosylates; Addition reaction with HX, NH3 and reaction with aqueous ROH with mechanism; Reduction reactions-catalytic reduction and Stephen's reaction, Condensation reactions-Thorpe Nitrile Condensation with mechanism.

Isonitriles: Introduction, Nomenclature and uses; Preparation of Isonitriles from Carbylamine reaction, substitution in alkyl halides and dehydrogenation of N-substituted formamides; discussion on reactions with mechanism of Hydrolysis and reduction; Discuss on reaction mechanism of addition with – HX, X2 and sulphur.

UNIT- II: Synthesis of Heterocycles

Heterocycles: Introduction, importance, classification, Nomenclature of heterocyclic compounds, General discussion on Structure.

Synthesis of furan, thiophene, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), General methods of synthesis for pyridine (Hantzsch synthesis) and for Indole (Fischer indole synthesis, Madelung synthesis, reduction of o-nitro benzaldehyde), Quinoline and isoquinoline: Synthesis: Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, Doebner-Miller synthesis, Bischler-Napieralski reaction, Pictet-Spengler reaction, Pomeranz-Fritsch reaction.

UNIT- III: Reaction of Heterocycles

Electrophilic substitution reaction of heterocycles: orientation effect of pyrrol, thiophene, pyridine, indole, quinolone for nitration, sulphonation, halogenation, formylation, mercuration, and carboxylation; reduction of heterocycles using Zn/HCl; Pd/Pt/H2; Na/EtOH; ring expansion reaction; reaction with alkali lithium reagents; discuss nucleophilic substitution reactions on the heterocycles; Mannich reaction

UNIT –IV: Fused aromatics

Fused aromatics: nomenclature of fused aromatics like naphthalene, anthracene, phenanthrene; compare their aromatic stabilization energy with respect to benzene, synthesis of these aromatic compounds (Howarth method, Pschorr synthesis, Elbs reaction); reactive carbon center toward electrophilic substitution reaction; nitration, sulphonation (TCP and KCP), acylation and halogenation; reaction with diazonium salts, peri-H interaction and reactivity of naphthalene.

UNIT - V: Pericyclic reaction

Molecular orbitals of conjugated alkenes; stereochemistry of electrocyclic reaction; disrotatory and conrotatory pathways, FMO approach of electrocyclic reaction; Woodward-Hoffman rules; selection rules for ectrocyclic reaction; correlation diagram; aromatic transition state: Huckel-Mobius approach; cyclocaddtion reaction; antarafacial and suprafacial modes of cycloaddition; symmetry allowed and forbidden reaction; FMO approach; selection rules; Diels-Alder reaction; exo and endo selectivity; reactivity and regioselectivity of D-A reaction; sigmatropic reaction; selection rules of it; [1,3] and [1,5] sigmatropic shifts; ene reaction.

Learning Resources	**Theory:** 1. M. B. Smith and J. March, March's Advance Organic Chemistry, 6th Ed., John Wiley and Sons, Inc. 2. J. Clayden, N. Greeves, and S. Warren, Organic Chemistry 2nd Ed., Oxford. 3. J. McMurry, Organic Chemistry 5th Ed., Thomson. 4. T. W. G. Solomons and C. B. Fryhle, Organic Chemistry 10th Ed., John Wiley and Sons, Inc. 5. I. L. Finar and A. L. Finar, Organic Chemistry Vol. 2, Addison-Wesley. 6. S. Sen Gupta, Basic Stereochemistry of Organic Molecules 3rd ED., Book Syndicate Pvt Ltd.

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	20%	-	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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	Dr. S. Pramanik, SRMIST
	Dr. Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru Email: kanishka@jncasr.ac.in	Prof. M. Arthanareeswari, SRMIST

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Course Code	UCY22503T	Course Name	Molecular Spectroscopy and Photochemistry	Course Category	C	Core Course	L	T	P	C
							4	0	0	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 basic principles of light-matter interactions and learn quantum mechanical methods to analyze the interactions	
CLR-2	Enable the students to acquire quantitative skills in volumetric analysis.	
CLR-3	Inculcate the practical and theoretical knowledge about the chemical kinetics	
CLR-4	Acquire knowledge in the fundamentals of electronic spectroscopy	
CLR-5	Understand the principles of photochemistry	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1 Disciplinary Knowledge	2 Critical Thinking	3 Problem Solving	4 Analytical Reasoning	5 Research Skills	6 Team Work	7 Scientific Reasoning	8 Reflective Thinking	9 Self-Directed Learning	10 Multicultural Competence	11 ICT Skills	12 Life Long Learning	13 PSO -1	14 PSO -2	15 PSO-3
CLO-1	Understand the basic principles of light-matter interactions and learn quantum mechanical methods to analyze the interactions	4	H	-	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-2	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	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-3	Learn various spectroscopic methods based on the magnetic resonance principles	4	H	-	-	-	M	-	-	-	-	-	-	-	-	-	-
CLO-4	Analyze spectroscopic information to obtain structural information of molecules	4	-	-	H	H	-	-	-	-	-	-	-	-	-	-	-
CLO-5	Apply the principles of photochemistry to the molecules in excitation and calculate relevant parameters	4	-	-	-	H	H	-	H	-	-	-	-	-	-	-	-

UNIT I Fundamentals of Molecular Spectroscopy:
Region of electromagnetic spectrum, Interaction of electromagnetic radiation with matter, emission and absorption spectra, signal to noise ratio and resolving power, width and intensity of spectral transitions, Fourier Transforms in spectroscopy, transition probability and selection rules.

UNIT II Rotational and rotation-vibrational spectroscopy: pure rotational spectra, diatomic rigid rotor molecules, effect of isotope substitution, vibrational and vibration- rotational spectra of diatomic molecules, harmonic oscillator-rigid rotor approximation, anharmonicity effect, normal modes of vibration, infrared spectra of linear and bent AB2 molecules, skeletal vibration and group frequency.

UNIT III Raman spectroscopy: Raman Effect, rotational and rotation- vibrational Raman transitions, nuclear spin effects, polarization of Raman lines.

UNIT IV Electronic spectroscopy: Vibronic spectroscopy of diatomic molecules, Franck-Condon factor, dissociation and pre-dissociation, rotational fine structure, solvent effects.

UNIT V Photo Chemistry: Introduction Characteristics of electromagnetic radiation- Consequences of light absorption –Jablonski diagram- Beer-Lamberts law- Physical significance of molar absorption coefficients. Laws of photochemistry - Experimental determination of quantum yield- actinometer- Types of photochemical reaction- Example of low and high quantum yields- Rate law for photochemical reaction- Kinetics of photochemical reaction- Photosensitized reaction, Fluorescence quenching- Stern-volmer equation- Chemiluminescence- Role of photochemical reaction in biochemical process- Photostationary state- Photocatalytic decomposition of HI- Lasers- Geometry of excited state and its life time.

Learning Resources

Theory:

1. Modern Spectroscopy, J. M. Hollas, 4th edition (2004), John Wiley & Sons, Ltd., Chichester.
2. Introduction to Molecular Spectroscopy, G. M. Barrow, (1962) McGraw-Hill.
3. Fundamentals of Molecular Spectroscopy, C. N. Banwell and E.M. Mc Cash, 4th edition, (1994), Tata McGraw Hill, New Delhi.
4. N. J. Turro, Modern Molecular Photochemistry, University Science Books, Sausalito (1991).

	5. C.H. Depuy and O.L. Chapman, Molecular Reactions and Photochemistry, 2nd Edition (1988), Prentice-Hall of India (P) Ltd., New Delhi

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	20%	-	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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	Dr. Srinivasarao Kancharla, SRMIST
	Dr. Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru Email: kanishka@jncasr.ac.in	Prof. M. Arthanareeswari, SRMIST

Course Code	Course Code	UCY22D03T	Course Name	Solid state chemistry and its applications	Course Category	D	Discipline Specific Elective	L	T	P	C
								3	0	0	3

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 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:	Learning Level of Thinking (Bloom)	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	ICT Skills	Life Long Learning	PSO -1	PSO -2	PSO-3
CLO-1:	Understand basic concepts of solid-state chemistry and its applications	4	H	-	H	H	-	-	-	-	-	-	-	-	H	-	-
CLO-2:	Gain knowledge about crystal defects and non-Stoichiometry	4	H	-	M	H	-	-	-	-	-	-	-	-	-	H	-
CLO-3:	Understand the mechanism of different types of synthesis	4	-	H	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	-	H	-	M	-	-	-	-	-	-	H	-

Unit-1 Crystal Structures and Crystal Chemistry

Introduction, Classification of solids, differences between crystalline and amorphous solids, point group, Crystallography-Law of constancy of interfacial angles, Law of rational indices and Miller indices, d-Spacing Formulae, Law of Symmetry and types of crystal symmetry, space lattice and unit cell-primitive and non-primitive unit cells, Seven crystal systems, Bravais and non-Bravais lattices. Close Packed Structures of Solids in ID, 2D and 3D, cubic closed packing, hexagonal closed packing, face-centred cubic and body-centred cubic structure. Total number of atoms per unit cell, relationship between the edge length of a cubic unit cell and the radius of atom, and the relative density of packing -simple cubic, face-centred cubic and body-centred cubic system. Types of crystals-Ionic crystals, Structures of NaCl, CsCl, Zinc blende, Wurtzite, Rutile and Perovskit, Covalent crystals, structure of diamond and graphite, Metallic and Molecular Crystals.

Unit-II Crystal Defects, Non-Stoichiometry and Diffraction

Types of Defect- Point, line and plane defects; intrinsic and extrinsic defects-vacancies, Schottky and Frenkel defects, The Kroger–Vink notation for crystal defects, Thermodynamics of Schottky and Frenkel defect formation, Colour centres. Vacancies and interstitials in non-stoichiometric crystals: extrinsic and intrinsic defects, Defect clusters or aggregates, Interchanged atoms: order–disorder phenomena, X-Ray Diffraction and Bragg's law, diffraction methods-Laue method, the rotating crystal method and the powder method.

Unit-III Synthesis, Processing and Fabrication Methods

Solid State Reaction or Shake 'n Bake Methods-Nucleation and Growth, Epitaxy and Topotaxy, Examples of Solid-State Reactions, Combustion Synthesis and Mechanosynthesis. Low Temperature or Chimie Douce Methods-Alkoxide Sol–Gel Method, Sol–Gel Method Using Oxyhydroxides and Colloid Chemistry, Citrate Gel and Pechini Processes, Use of Homogeneous, Single-Source Precursors, Hydrothermal and Solvothermal Synthesis, Microwave Synthesis, Intercalation and Deintercalation- Graphite Intercalation Compounds, Pillared Clays and Layered Double Hydroxides and Synthesis of Graphene, Gas-Phase Methods-CVD, PVD, ALD, Sputtering and Evaporation and Aerosol Synthesis and Spray Pyrolysis.

Unit-IV Thermal and Electrical Properties

Thermal Properties: Lattice vibrations - phonon spectrum; lattice heat capacity; thermal expansion; thermal conductivity.

Electrical Properties: Electrical conductivity and Ohm's law, Hall effect, band theory, intrinsic and extrinsic semiconductors, hopping semiconductors, semiconductor/metal transition, p-n junctions, superconductors - Meissner effect - type I and II superconductors, basic concepts of BCS theory, manifestations of the energy gap - Josephson devices.

Unit-V Magnetic and Optical Properties

Magnetic Properties: Classification of magnetic materials, Langevin diamagnetism, quantum theory of paramagnetism, cooperative phenomena ferro-, antiferro- and ferri-magnetism, magnetic domains and hysteresis, super paramagnetism.

Optical properties: Optical reflectance, plasmon frequency, Raman scattering in crystals, photoconduction, photo and electroluminescence, photovoltaic, and photoelectrochemical effects.

Learning Resources	
	1. A. R. West, Solid State Chemistry and Its Application, 2ed, Wiley, 2014.
	2. Atkins, Peter, Overton, Tina, Rourke, Jonathan, Weller, Mark and Armstrong, Fraser Shriver & Atkins' Inorganic Chemistry, 5th Edition, Oxford University Press 2011-2012
	3. C. N. R. Rao and J. Gopalakrishnan, New Directions in Solid State Chemistry, 2ed, Cambridge University Press, 2010.
	4. P. A. Cox, The Electronic Structure and Chemistry of Solids, Oxford Science Publications, 1987.

	5. G. Gottstein, Physical Foundation of Material Science, Springer, 2004. 6. Adam, D.M. 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	20%	-	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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. S. Shanmugan, SRMIST
	Dr. Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru Email: kanishka@jncasr.ac.in	Prof. M. Arthanareeswari, SRMIST

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Course Code	UCY22D04T	Course Name	Industrial chemistry	Course Category	D	Discipline Specific Elective	L	T	P	C
							3	0	0	3

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:	To familiarize the students on industrial chemistry
CLR-2:	To gain knowledge in various industrial fuels
CLR-3:	To study in depth about the use of various fertilizers in agriculture
CLR-4:	To learn the basic concepts in water treatment and about pollution control
CLR-5:	To gain knowledge about the manufacture of cement and glass

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning Level of Thinking (Bloom)	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	ICT Skills	Life Long Learning	PSO -1	PSO -2	PSO-3
CLO-1:	Give an overview about the industrial fuels	4	H	-	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-2:	Explain the types and the applications of fertilizers and pesticides	4	H	-	-	-	-	-	M	-	-	-	-	-	-	-	-
CLO-3:	Demonstrate the sequential steps involved in the waste water treatment	4	H	-	-	-	M	-	-	-	-	-	-	-	-	-	-
CLO-4:	Develop an innovative technology for pollution control and management	4	-	-	M	H	-	-	-	-	-	-	-	-	-	-	-
CLO-5:	Demonstrate the manufacturing process of cement, glass and ceramics	4	-	-	-	-	H	H	-	-	H	-	-	-	-	-	-

UNIT- I: Industrial Fuels

Energy sources- Classification of fuels –solid- liquid and gaseous. Calorific value of fuels and its determination. Solid fuels – coal- lignite- sub-bituminous coal- bituminous coal and anthracite. Coking and non-coking coal. Liquid fuels – petroleum refining and uses. Hydrodesulphurisation and cracking (thermal and catalytic - fixed bed and fluidised bed). Octane number. Production and uses of tetraethyl lead- ETBE and MTBE. Gaseous fuels - natural gas and gobar gas –production- composition and uses-gobar electric cell.

UNIT - II: Chemistry in Agriculture

Fertilizers- NPK- superphosphate- triple superphosphate- uses of mixed fertilizers. Micronutrients and their role, biofertilizers- plant growth harmones.

Pesticides- classification of pesticides with examples. Insecticides - stomach poisons- contact insecticides- fumigants. Manufacture and uses of insecticides. DDT- BHC (gammaxane: Conformation of gamma isomer) pyrethrin, banned pesticides. Herbicides -manufacture of 2,4-D and 2,4,5-T. Fungicides -preparation of Bordeaux mixture-lime-sulphur creosote oil (formula only).

Sugar industry - double sulphitation process. Refining and grading of sugar. Saccharin - use as a sugar substitute-aspartame.

UNIT - III: Water Treatment

Introduction-sources of water. Hardness of water- temporary and permanent hardness - units of hardness- disadvantages of hard water. Effect of iron and manganese in water. Estimation of hardness – EDTA method and alkali titration method. Water softening methods - Zeolite process- ion-exchange demineralisation- mixed – bed deionisation. Domestic waste water treatment. Purification methods – chlorination- break point chlorination. Reverse osmosis - Desalination.

UNIT - IV: Chemical Toxicology, Manufacturing and Hazards in Handling Chemicals

Chemical toxicology: Effect of toxic chemicals on enzymes. Lead- mercury and cyanide pollution and their biochemical effects. Carbon monoxide, sulfur dioxide- oxides of nitrogen- ozone - biochemical effects.

Manufacturing and Hazards in Handling Chemicals: Manufacture of hydrochloric acid, nitric acid, sulphuric acid, Caustic soda and borax, hazards in handling the chemicals - hydrochloric acid, nitric acid, sulphuric acid, Caustic soda and borax, hydrogen peroxide and bleaching powder:

UNIT -V: Cement, Glass and Ceramics

Cement: Manufacturing – Wet Process and Dry process- types- analysis of major constituents- setting of cement- reinforced concrete. Cement industries in India. Glass: Composition and manufacture of glass. Types of glasses- optical glass- coloured glasses and lead glass. Ceramics: Types- raw materials- white wares- manufacture and uses.

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

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	20%	-	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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	Prof. M. Arthanareeswari, SRMIST
	Dr. Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru Email: kanishka@jncasr.ac.in	Dr. T. Pushpa Malini, SRMIST

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Course Code	UCY22D05T	Course Name	Green chemistry	Course Category	D	Discipline Specific Elective	L	T	P	C
							3	0	0	3

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:	Learn the principles of green chemistry
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 trends in Green chemistry

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
			Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	ICT Skills	Life Long Learning	PSO -1	PSO -2	PSO-3
CLO-1 :	Gain knowledge about the principles of Green chemistry.	4	H	-	-	-	-	-	-	-	-	-	-	H	-	-	-
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	-	-	-	M	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Utilize the knowledge gained in the course for experimenting with solvent less reactions	4	-	-	H	H	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Identify reactions wherein sustainable synthetic methods can be employed	4	-	-	-	H	H	-	H	-	H	-	-	-	-	-	-

UNIT- I: Introduction to Green Chemistry

Green chemistry - Anastas' twelve principles of green chemistry -Principle of atom economy. Examples of reactions following the principles of green chemistry and atom economy.

A) Green Preparation of propene

B) Green synthesis of Ibuprofen

UNIT- II: Green Reactions

Acetylation of primary amine, base catalyzed aldol condensation (synthesis of dibenzalpropanone)- halogen addition to C=C bond (bromination of trans-stilbene)- [4+2] cycloaddition reaction (Diels-Alder reaction between furan and maleic acid). Rearrangement reaction (benzyl-benzilic acid rearrangement)- coenzyme catalyzed benzoin condensation (thiamine hydrochloride catalyzed synthesis of benzoin

UNIT- III: Green Solvents

Introduction –classification of ionic liquids- synthesis of ionic liquids – Ionic liquids: simple preparation – types – properties and application – ionic liquids in organic reactions (Heck reaction, Suzuki reactions and epoxidation)- Analytical chemistry - gas chromatography stationary phases – advantages and disadvantages. Reactions in water and supercritical water and carbon dioxide.

UNIT- IV: Green Catalyst

Supported metal catalysts – mesoporous silica. Phase transfer catalyst - Synthesis – applications. Magnetically recoverable catalysts.

UNIT- V: Advancements in green chemistry

Photo reduction of benzophenone to benzopinacol using sunlight. Photochemical alternative to Friedel-Crafts reaction and use of dimethyl carbonate as a methylating agent. Reaction in water - furan and maleic acid. Supercritical liquids – water and CO2. Extraction of D-limonene from orange peel. Green chemistry examples based on sonochemistry and mechanochemistry and photochemical principles in green chemistry, Green chemistry in sustainable development.

Learning Resources

Theory:

1.Ahluwalia, V.K., Kidwai, M.R. New Trends in Green Chemistry, Anamalaya Publishers, 2005.

2. Anastas, P.T. & Warner, J.K, Green Chemistry- Theory and Practical, Oxford University Press, 1998.

3. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker, 2001.

4. Cann, M.C.and Connely, M.E. Real-World cases in Green Chemistry, ACS 2000.

5. Ryan, M.A. and Tinnesand, M. Introduction to Green Chemistry, American Chemical Society, 2002.

6. Lancaster, M. 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	20%	-	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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	Prof. M. Arthanareeswari, SRMIST
	Dr. Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru Email: kanishka@jncasr.ac.in	Dr. T. Pushpa Malini, SRMIST

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Course Code	UCY22D06T	Course Name	Introduction to computational Chemistry	Course Category	D	Discipline specific elective	L	T	P	C
							3	0	0	3

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 knowledge on the force field and electronic structure methods.
CLR-2 :	Acquire knowledge about correlation method and basis set.
CLR-3 :	Promote the use of DFT and other relativistic methods.
CLR-4 :	Understand the wave function principles and computable molecular properties
CLR-5 :	Acquire practical understanding on employing these methods.

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 Disciplinary Knowledge	2 Critical Thinking	3 Problem Solving	4 Analytical Reasoning	5 Research Skills	6 Team Work	7 Scientific Reasoning	8 Reflective Thinking	9 Self-Directed Learning	10 Multicultural Competence	11 ICT Skills	12 Life Long Learning	13 PSO -1	14 PSO -2	15 PSO-3
CLO-1 :	Understand the force field and electronic structure methods.	4	H	H	H	-	H	-	H	H	H	-	H	H	H	H	H
CLO-2 :	Gain knowledge about the correlation method and basis set	4	H	H	H	H	H	-		H	H	H	-	-	H	H	H
CLO-3 :	Understand about DFT and other methods	4	H	H	H		H	-	H	H	H		H	-	H	H	H
CLO-4 :	Understand the wave function principles and computable molecular properties	4	H	H	H	H	H	H	H	H	H	H	-	H	H	H	H
CLO-5 :	acquire practical understanding on employing these methods.	4	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H

Unit-1: Introduction

A Brief Review of Elementary Quantum Chemistry-General Introduction to Electronic Structure Theory-An Introduction to Electronic Structure Theory Mathematics and Notation-Introduction to Molecular Mechanics-Scope of computational chemistry-Fundamental Assumptions-Potential Energy Functional Forms- Force-field Energies and Thermodynamics-Geometry Optimization- Advantages and Limitations of Force Field Methods- Common Force Field Terms.

Unit-II: Foundations of Molecular Orbital Theory

Quantum Mechanics and the Wave Function-The Hamiltonian Operator-Construction of Trial Wave Functions- The Adiabatic and Born–Oppenheimer Approximations-Self-Consistent Field Theory-The Energy of a Slater Determinant-Koopmans' Theorem-SCF Techniques-Semi-Empirical Methods-Performance of Semi-Empirical Methods-Hückel Theory-Limitations and Advantages of Semi-Empirical Methods.

Unit-III: Hartree–Fock Method

Slater determinants, anti-symmetry principle-deriving the Hartree-Fock equations-Hartree-Fock energy expressions for arbitrary spin-orbital configurations-restricted and unrestricted references-self-consistent-field (SCF) procedure-General Performance Overview of Ab Initio HF Theory-Basis sets-Slater and Gaussian functions-contractions-polarization and diffuse functions-split-valence sets-correlation-consistent sets-core-valence sets-general contractions-EMSL basis set exchange-Electron Correlation Methods.

Unit-IV: Density Functional Theory

Theoretical Motivation- The Hohenberg–Kohn Existence Theorem- The Hohenberg–Kohn Variational Theorem- Kohn–Sham Self-consistent Field Methodology- Exchange-correlation Functionals- Advantages and Disadvantages of DFT Compared to MO Theory-Limitations of the KS Formalism

UNIT-V: Illustrating the Concepts

Geometry, total energy, dipole moment and vibrational frequency convergence – Vibrational frequency analysis: symmetry analysis, harmonic vs fundamental-frequencies, zero-point vibrational energies (ZPVE's), Hessian index, distinguishing minima from transition states- Intrinsic reaction coordinate (IRC) analysis-Electrostatics- atomic charges-dipole moment-polarizability-hyperpolarizability.

Learning Resources

Theory:

1. Frank Jensen, Introduction to Computational Chemistry, John Wiley & Sons,1999.
2. Cramer, C.J., Essentials of Computational Chemistry, John Wiley & Sons, 2004.
3. Lewars, E., Computational Chemistry, Kluwer academic Publisher, 2003.
4. A. Szabo and N. S. Ostlund, Modern Quantum Chemistry, Introduction to Advanced Electronic Structure Theory, 1st ed., revised (Dover, 1989). More mathematical detail for many of the ab initio electronic structure methods.
5. D. A. McQuarrie, Quantum Chemistry (University Science Books, Mill Valley, CA, 1983).Very readable introductory text for undergraduate-level quantum chemistry.

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	20%	-	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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. E. Varathan, SRMIST
	Dr. Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru Email: kanishka@jncasr.ac.in	2.Prof. M. Arthanareeswari, SRMIST

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SEMESTER VI

Course Code	UCY22601J	Course Name	Analytical chemistry	Course Category	C	Core Course	L	T	P	C
							4	0	4	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:	Understand the fundamental principles of analytical chemistry and data analysis	
CLR-2:	Be aware about modern analytical techniques and their applications	
CLR-3:	Learning basics of separation techniques and its applications and understanding analytical tools, statistical methods in analytical chemistry.	
CLR-4:	Understanding principles of thermo-gravimetric analysis and study of thermal decomposition of materials/characterization of materials.	
CLR-5:	Understanding basics of electro-analytical techniques and their 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 Disciplinary Knowledge	2 Critical Thinking	3 Problem Solving	4 Analytical Reasoning	5 Research Skills	6 Team Work	7 Scientific Reasoning	8 Reflective Thinking	9 Self-Directed Learning	10 Multicultural Competence	11 ICT Skills	12 Life Long Learning	13 PSO -1	14 PSO -2	15 PSO-3
CLO-1:	Develop methods of analysis for different samples independently.	4	H	H	H	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2:	Perform experiment with accuracy and precision.	4	H	H	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-3:	Develop skills for separation of analytes by chromatography.	4	H	H	H		-	-	-	-	-	-	-	-	-	-	-
CLO-4:	Perform Thermo-gravimetric Analysis of different compounds	4	H	-	H	H	-	-	-	-	-	-	-	-	-	-	-
CLO-5:	Posses' analytical experience on interpretation of GC/HPLC data of known compounds.	4	-	H	-	M	-	-	-	-	-	-	-	-	-	-	-

Unit - I: Data Analysis and Good lab practice

Principle of GLP and handling of first aid. Safety, storage and handling of chemicals. Definition for Antidotes with examples, threshold vapour concentration and its safety limits. Accuracy and precision definitions, Definition and importance of Sensitivity and specificity. Definition and problems based on Standard deviation and mean. Errors, Classification of errors- systematic (determinate), random (indeterminate). Minimization of errors. Definition - significant figures. Problems based on significant figures. Rejection of data and its criteria. Q test, T test, F test Definitions - control chart, sampling methods. Sampling error and statistical data treatment, Standard reference materials.

Unit - II: Classical analytical methods

Principle of volumetric analysis. Concept of solubility product. Common ion effect and its applications in qualitative and volumetric analyses. Principles of gravimetric analysis, Gravimetric methods and its applications. Theories of Precipitation, Precipitation from homogenous medium. Co-precipitation reactions, Post precipitation reactions with examples. Titrations, Theories of acidbase titration, Redox and complexometric titrations. Iodimetric titrations. Buffer solutions with examples. Indicators – theories of indicators. acid-base indicators and redox-metal ion. Adsorption indicators and metal ion indicators. choice of indicators. Limitations of volumetric analysis.

Unit - III: Analytical separation and purification techniques

Precipitation – definition with examples. Separation techniques and types. Distillation- definition with examples Types of distillation – steam, fractional and vacuum. Solvent extraction principles. Chromatography - principle and its types. Partition chromatography, Column chromatography and its applications. Thinlayer chromatography (TLC) and its applications. Paper chromatography and its applications. Ion exchange chromatography: principle. Instrumentation and applications. Suppressor columns Principles, instrumentation and applications of GC. HPLC – Principles, Instrumentation and applications. Signal to noise ratio. Sources of noise in instrumental analysis.

Unit - IV: Electrochemical analysis

Specific Conductance and Molar conductance. Kohlrausch's law and its applications. Measurement of dissociation constant. coulometric titrations. conductometric titrations. Introduction to electrochemical cells. Types of Electrochemical Cells - Galvanic cells and Electrolytic cells. Standard electrode potential, and electrochemical series. Nernst equation. Potentiometry – basic principles. Ion-selective electrodes. Liquid membrane electrodes – applications. Voltammetry principles and applications. Voltammograms, equation of voltammogram and modified voltametric methods. Cyclic voltammetry, amperometry and anodic stripping voltammetry. Polarography basic principles and applications. Electrochemical Sensors, modified electrodes and their applications, Principle, instrumentation, operation and applications of electronic tongue.

Unit - V: Thermal analysis

Introduction. Description of Thermo-analytical methods. Principle of TGA, Instrumentation and applications. Principle of DTA , Instrumentation and applications, Principle of DSC , Instrumentation and applications. Characteristics of TGA curves, DTA, thermograms. Factors affecting TGA curves, Thermograms of calcium oxalate monohydrate. Factors affecting DTA curves, DTA curves of calcium oxalate monohydrate and others. Advantages of TGA, Advantages of DTA, Thermometric titration, Principle and applications. Electrogravimetry, Principle and applications.

PRACTICALS:

1. Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the Rf values
2. Detection of amino acids by ninhydrin after thin layer chromatographic separation.
3. Determination of chloride and iodide from given mixture by potentiometry.
4. Determination of amount of copper and iron(III) from the given mixture by spectrophotometric titration using standard EDTA solution.
5. Estimation of aspirin from given tablet by spectrophotometry
6. Determination of relative strength of acetic acid, chloroacetic acid and trichloroacetic acid through measuring their Ka value by conductivity measurement method.
7. Determination of glucose from unknown sample (eg. glucon D) by titration with Fehling solution.
8. Determination of the isoelectric pH of a protein.

Learning Resources	**Theory:** 1. D. A. Skoog, D. M. West, F. J. Holler and S. R. Crouch, Fundamentals of AnalyticalChemistry, 9th Ed., Brooks Cole, 2013. 2. G. D. Christian, Analytical Chemistry, 6th Ed., Wiley, 2007. 3. D. A. Skoog, F. J. Holler and S. R. Crouch, Principles of Instrumental Analysis, Thomson Learning, 2007. 4. H. H. Willard, L. Jr. Merritt., J. A. Dean and F. A. Settle, Instrumental Methods of Analysis,7th Ed., CBS Publishers, 2007. 5. R.M. Verma, Analytical Chemistry Theory and Practice, 3rd Ed., CBS Publishers, 1994. 6. B. K. Sharma, Instrumental Methods of Analysis, 28th Ed., GOEL Publishing House, 2012. 7. N. Gray, M. Calvin and S.C. Bhatia, Instrumental Methods of Analysis, CBS Publishers, 2009.	**Practicals:** 1. Seamus P.J. Higson: Analytical Chemistry. 2. Douglas A. Skoog and Donald M..West: Fundamentals of Analytical Chemistry. 3. Vogel's textbook of quantitative chemical analysis, 7th edition. 4. Dean J. A. :Analytical Chemistry Handbook, McGraw Hill, 2007 5. Principles of Instrumental Analysis - 6th Edition by Douglas A. Skoog, F. James Holler, and Stanley Crouch (ISBN 0-495-01201-7) 6. Instrumental Methods of Analysis, 7thed, Willard, Merritt, Dean, Settle. 7. Adion A. Gordus: Schaum's Outline of Analytical Chemistry, Tata McGraw-Hill. 8. Gary D. Christian : Analytical Chemistry . 9. Freifelder and Kealy: Analytical Chemistry .D.A. Skoog, D.M. West and F.J. Holler, Analytical Chemistry: An Introduction, 5th edition, Saunders college publishing, Philadelphia, 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	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Level 2	Understand	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Level 3	Apply	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Level 4	Analyze	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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.Samarendramaji, SRMIST
	Dr. Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru Email: kanishka@jncasr.ac.in	2.Prof. M. Arthanareeswari, SRMIST

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Course Code	UCY22602T	Course Name	Organometallic and Bioinorganic Chemistry	Course Category	C	Core course	L	T	P	C
							4	0	0	4

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

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 Problem Analysis	3 Design & Development	4 Analysis, Design, Research	5 Modern Tool Usage	6 Society & Culture	7 Environment & Sustainability	8 Ethics	9 Individual & Team Work	10 Communication	11 Project Mgt. & Finance	12 Life Long Learning	13 PSO - 1	14 PSO - 2	15 PSO – 3
CLO-1:	Apply 18-electron rule to rationalize the stability of organometallic compounds	4	H	-	H	H	-	-	-	-	-	-	-	-	H	-	-
CLO-2:	Employ concepts of organometallic chemistry in fine chemical for industry	4	H	-	-	H	H	-	-	-	-	-	M	-	-	H	-
CLO-3:	Develop a general idea of catalysis and describe the mechanism in detail	4	-	H	-		-	-	-	-	-	-	-	-	H	M	-
CLO-4:	Solve periodically by incorporation of organometallic compounds into organic synthesis problems	4	H	H	-	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	H	-	-	H	-	-	-	-	-	-	-	H	-

Unit-I: Introduction to organometallic chemistry

Type of ligands and coordination-hapticity, eighteen electron rule-Electron counting and limitations, transition metal carbonyl complexes-synthesis and reactivity, substitutes for carbonyl ligands, non-carbon ancillary ligands-phosphine, isocyanide, nitrosyl containing complexes, ligand substitution reactions, ligand insertion reactions. Structure of mono and polynuclear metal carbonyl, Infrared spectroscopy, metal dinitrogen and dioxygen complexes, metal hydride complexes, transition metal organometallics: square planar complexes, vaskas complex-synthesis and reactivity, metal alkyls and aryls, metal carbene and carbyne complexes, metal alkylidenes and metal alkylidynes, isolobal analogy, fluxional properties of organometallics.

Unit-II: Organometallic compounds containing π systems, synthesis and properties

Synthesis, structure, bonding and reactivity of transitional metal complexes with alkenes, alkynes and alkynes derived compounds, π-allyl, and enyl, butadiene, pentadienyl complexes, cyclobutadiene, cyclopentadienyl- metallocenes, arene, cycloheptatriene, cyclooctatetraene, benzenoid, migratory insertion reaction with alkenes, alkynes, agostic C-H and carbene, substitution reactions-electrophilic and nucleophilic attack on coordinated ligands, oxidative addition, reductive elimination, transmetallation, insertion, and (β-hydride and alkyl) elimination reactions, reactions involving organocopper and palladium intermediates and other transition metals, Suzuki, Stille, Negishi and Ullman coupling reactions with mechanism, Heck reaction with mechanism.

Unit-III: Catalytic reactions and their applications

Homogeneous catalysis: feedstocks for chemical industry, metathesis, hydrogenation, hydroformylation, acetic acid synthesis, heterogeneous catalysis: Fischer-Tropsch reaction and Ziegler-Natta polymerization, polymer-bound catalysts, olefin oxidation, addition of HX to olefins, carbonyl insertion, hydride elimination, abstraction, C-C bond forming reactions such as Pauson-Khand reaction, alkyne cyclotrimerization, vollhardt reaction and oligomerization reaction, Dötz reaction, ethylene dimerization using $RhCl_3$ as catalyst, surface and supported organometallic catalysis. Metal (Rh, Ir) catalyzed C-H activation reactions and their synthetic utility.

Unit-IV: Introduction to Bioinorganic Chemistry: Porphyrin systems and their functions

Essential and non – essential metals, Toxicity of metals - Cd, Hg and Cr toxic effects with specific examples. ion (Na+ and K+) transport-ion channel, ion carrier and ion pump, Transition elements in biology - their occurrence and function, active-site structure and function of heme proteins with various transition metal ions and ligand systems, Porphyrins, Photosystems I and II - Primary Process in Photosynthesis, Chlorophylls, haemoglobin and myoglobin- their coordination geometry, electronic structure and co-operativity effect, oxygen binding, transport and utilization, Bohr effect, Cytochromes-types- structure and electron transfer reactions, Cytochrome P-450: A Monooxygenase, Catalase and Peroxidase.

Unit-V: Non-Porphyrin systems and their functions

Non-heme proteins-hemocyanin & hemerythrin, their coordination geometry, electronic structure and oxygen bindings, electron transfer proteins, active site structure and functions of ferredoxin, rubridoxin. nitrogen fixation, metalloenzymes containing molybdenum and iron. Cobalt: Cobalamine based enzymes. Nickel: Urease; Hydrogenases; Carbonmonooxide Dehydrogenases. Copper: Electron Transport; Oxidases; Monooxygenases; Dioxygenases; Various types of copper centers; Super oxide dismutase. Zinc: Carboxypeptidase A, and Carbonic Anhydrase, Vanadium in haloperoxidases, Metals in medicine - therapeutic applications of cis-platin, radio-isotopes(e.g., Tc & I2) and MRI agents.

Learning Resources

1. Cotton, F.A., Wilkinson, G., & Gaus, P.L. Basic Inorganic Chemistry 3rd Ed.;Wiley India.
2. Huheey, J. E.; Keiter, E.A. & Keiter, R.L. Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed., Harper Collins 1993, Pearson 2006.
3. Spessard, G. O., Miessler, G. L. Organometallic Chemistry, Prentice Hall, 1997.
4. Douglas, B. E.; McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry 3rd Ed., John Wiley and Sons, NY, 1994.
5. Purcell, K.F. & Kotz, J.C., Inorganic Chemistry, W.B. Saunders Co. 1977
6. Greenwood, N.N. & Earnshaw, A. Chemistry of the Elements 2nd Ed, Elsevier, 1997 (Ziegler Natta Catalyst and Equilibria in Grignard Solution).
7. Powell, P. Principles of Organometallic Chemistry, Chapman and Hall, 1988.
8. Bertini, I., Gray, H. B., Lippard, S. J. , Valentine, J.S. Bioinorganic chemistry, University Science Books, 1994.
9. Cowan, J. A. Inorganic Biochemistry: An Introduction, VCH Publishing, 1993.
10. Kaim, W., 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	20%	-	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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. S. Shanmugan, SRMIST
	Dr. Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru Email: kanishka@jncasr.ac.in	*Prof. M. Arthanareeswari,* SRMIST

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Course Code	UCY22603T	Course Name	Organic name reactions and reagents	Course Category	C	Core Course	L	T	P	C
							4	0	0	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 knowledge on the importance of organic name reactions
CLR-2:	acquire knowledge about condensation reactions.
CLR-3:	promote the importance of rearrangement reactions
CLR-4:	understand the uses of reagents and coupling reactions
CLR-5:	acquire basic understanding of Asymmetric synthesis

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
			Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	ICT Skills	Life Long Learning	PSO -1	PSO -2	PSO-3
CLO-1:	understand the basic concepts of organic name reactions	4	H	-	-	-	-	-	-	-	-	-	-	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	-	-	-	-	-	-	-	-	-	-
CLO-4:	apply the name reactions to synthesize in the laboratory	4	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-5:	gain basic understanding of synthesis of chiral compounds	4	-	H	-	-	-	-	H	-	-	-	-	-	-	-	-

UNIT- I: Organic name reactions

Arndt-Eistert Synthesis, Baylis-Hillman Reaction, Mannich Reaction, Click Chemistry, Corey-Chaykovsky Reaction, Corey-Seebach Reaction, Curtius Rearrangement (Reaction), Dakin Reaction, Darzens Reaction, Diels-Alder Reaction, Ene Reaction, Favorskii Reaction, Gabriel Synthesis, Grubbs Reaction, Haloform Reaction, Heck Reaction, Hell-Volhard-Zelinsky Reaction, Hunsdiecker Reaction, Kolbe-Schmitt Reaction, Mannich Reaction, McMurry Reaction, Michael Addition, Mitsunobu Reaction, Prévost Reaction, Reformatsky Reaction, Sandmeyer Reaction, Schmidt Reaction, Seebach Umpolung, Simmons-Smith Reaction, Ullmann Reaction, Vilsmeier Reaction, Wohl-Ziegler Reaction.

UNIT-II: Condensation, oxidation and reductions

Aldol Condensation, Acetoacetic Ester Condensation, Acyloin Condensation, Benzoin Condensation, Darzens Condensation, Dieckmann Condensation, Knoevenagel Condensation, Robinson Annulation, Olefin Metathesis, Swern Oxidation, Baeyer-Villiger Oxidation, Sharpless Epoxidation, Birch Reduction, Rosenmund Reduction, Clemmensen Reduction, Meerwein-Ponndorf-Verley Reduction, Yamaguchi Esterification

UNIT- III: Rearrangment

Beckmann Rearrangement, Benzilic Acid Rearrangement, Baker-Venkataraman Rearrangement, Brook Rearrangement, Claisen Rearrangement, Cope Rearrangement, Newman-Kwart Rearrangement, Overman Rearrangement, Oxy-Cope Rearrangement, Pinacol Rearrangement, [1,2] and [2,3]-Wittig Rearrangement, Wolff Rearrangement, Claisen Rearrangement, Fries Rearrangement, Newman-Kwart Rearrangement, Adamantane Rearrangement.

UNIT- IV: Reagents and Coupling

Collins Reagent, Corey reagent, Corey-Suggs Reagent, Koser's Reagent, Sarett Reagent, Tollen's reagent, Benedict's reagent, Bestmann's reagent, Burgess reagent.

Glaser Coupling, Hiyama Coupling, Kumada Coupling, Negishi Coupling, Nozaki-Hiyama Coupling, Pinacol Coupling Reaction, Sonogashira Coupling, Stille Coupling, Suzuki Coupling.

UNIT-V: Asymmetric synthesis

Introduction to asymmetric synthesis, Basic principles and examples of stereospecific, stereoselective, enantioselective and diastereoselective reactions, Cram's rule, Felkin-Cherest-Anh Rule, "anti-Cram"product, Industrial asymmetric synthesis; e.g. Chiral Drugs, Chiral Non-steroidal Anti-inflammatory Profen Drugs, Synthesis of Enantiomerically Pure Nucleosides including (-)Carbovir and Lamivudine, Captopril, Duloxetine..

Learning Resources

Theory:

1. W. Zerong Comprehensive Organic Name Reactions and Reagents ISBN: 9780471704508| Online ISBN: 9780470638859| DOI: 10.1002/9780470638859
2. 2. A. 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. 3. Bradford P. Mundy, Michael G. Ellerd, Frank G. Favaloro Jr., Name Reactions and Reagents in Organic Synthesis, Wiley-Interscience, 2nd ed., 2005.
4. 4. Mathias Christmann and Stefan Bräse, Asymmetric Synthesis: The Essentials, Wiley publication, 2007, ISBN 9783527320936.
5. 5. I. L. Finar, Organic Chemistry, Volume I, 6th Ed., 2015, ISBN: 9788177585421, 9788177585421.
6. 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	20%	-	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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	Dr. Palash Sanphui, SRMIST
	Dr. Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru Email: kanishka@jncasr.ac.in	Prof. M. Arthanareeswari, SRMIST

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Course Code	UCY22D07T	Course Name	Chemistry of Natural Products	Course Category	D	Discipline Elective Courses	L	T	P	C
							3	0	0	3

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 insight into different classes of natural products.
CLR-2 :	Understand the different methodology employed to isolate natural products
CLR-3 :	Learn suitable structural elucidation protocols to identify the natural product
CLR-4 :	Comprehend the commercial importance of natural products
CLR-5 :	Gather knowledge about agricultural production of herbal plant product

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 Disciplinary Knowledge	2 Critical Thinking	3 Problem Solving	4 Analytical Reasoning	5 Research Skills	6 Team Work	7 Scientific Reasoning	8 Reflective Thinking	9 Self-Directed Learning	10 Multicultural Competence	11 ICT Skills	12 Life Long Learning	13 PSO -1	14 PSO -2	15 PSO-3
CLO-1 :	Identify suitable sources for appropriate natural products	4	H	-	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-2 :	Use suitable methods to Isolate different type of natural products	4	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Apply methods to elucidate the structure of natural products	4	H	-	-	-	M	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Utilize the knowledge for commercial application of natural products	4	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Understand the biological importance of natural products	4	-	H	-	-	-	-	H	-	-	-	-	-	-	-	-

UNIT – I Alkaloids

Natural occurrence-General structural features and their physiological action. Hoffmann's exhaustive methylation, Emde's modification. Structural elucidation and synthesis of coniine, piperine, nicotine and papaverine. Marine sources of alkaloids

UNIT – II Terpenoids and Carotenoids

Terpenoids: Introduction, occurrence, isolation, classification, general characteristics of Terpenoids. Isoprene rule, Heme terpenoids, terpenes. Structural determination and synthesis of Acyclic monoterpenoids (Citral and Geraniol), Monocyclic mono terpenoids (Menthol) and Bicyclic monoterpenoids (camphor). Commercial applications

Carotenoids: Introduction, geometrical isomerism, structure determination and synthesis of b-carotene and vitamin-A

UNIT – III Anthocyanins and Flavones

Anthocyanins: Introduction to anthocyanins. Structure and general methods of synthesis of anthocyanins- Cyanidine chloride: structure and determination. Flavones: Structure and determination of flavone and flavonoids, Quercetin: Structure determination and bioactivity information.

UNIT – IV Purines and Steroids

Purines: Introduction, occurrence, isolation and biological importance. Synthesis and structural elucidation of Uric acid, Xanthine and Caffeine. Biological importance of cholesterol and oestrone (no structural determination and synthesis).

UNIT – V Natural Dyes and Indian Medicinal plants

General introduction and classification with special reference to textile and edible dyes and fabric brighteners. Occurrence, isolation, purification, colour and constitution. Structural determination and synthesis of indigoitin and alizarin.

Origin, Evolution and Cultivation methods of medicinal plants (Aloe vera, Ashwagandha, Brahmi, Kalmegh, Shankh pushpi Tulsi and turmeric)-storage and protection. Export of medicinally important plants (General aspects). Role of plant tissue culture in Natural product synthesis.

Learning Resources

Theory:

1. **O. P. Agarwal, Chemistry of Natural Products, Vol 1, Goel Publishing House, Meerut, 1997.**
2. **Gurdeep Chatwal and S.K. Anand, Chemistry of Natural Products, Himalaya Publishing Co, New Delhi, 2001.**
3. **L.Finar ,Organic Chemistry, Vol 2, 5th edition, Pearson education, 1975.**
4. **A.A. Faroogi and B.S. Sreeramu, Cultivation of Medicinal and Aromatic Crops**

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	20%	-	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	Create	-	-	-	-	-	-	-	-	-	-
	Total	100 %		100 %		100 %		100 %		100 %	

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. M. R. Ganesh, SRMIST**
	Dr. Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru Email: kanishka@jncasr.ac.in	Prof. M. Arthanareeswari, SRMIST

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Course Code	UCY22D08T	Course Name	Biopolymers and biocomposites	Course Category	D	Discipline Specific Elective	L	T	P	C
							3	0	0	3

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:	To get a basic knowledge about the biopolymers and their applications
CLR-2:	To impart knowledge on principles of biodegradation
CLR-3:	To impart knowledge on different types of biodegradable polymers properties and their applications.
CLR-4:	Acquire knowledge on the structure of biopolymers
CLR-5:	Enrich knowledge on biocomposites and their applications

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
			Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	ICT Skills	Life Long Learning	PSO -1	PSO -2	PSO-3
CLO-1:	Students will show concerned for environment by using synthetic biodegradable polymers	4	H	_	–	–	–	–	–	–	–	–	–	H	–	–	–
CLO-2:	Students will develop capacity to comprehend biopolymers and their application areas and particular requirements of biodegradable polymers	4	H	H	–	–	H	–	–	–	–	–	–	–	–	–	–
CLO-3:	Knows the most common natural and synthetic biodegradable polymers	4	H	–	–	–	M	–	–	–	–	–	–	–	–	–	–
CLO-4:	Can define what is biodegradation and how it is measured	4	–	–	H	H	–	–	–	–	–	–	–	–	–	–	–
CLO-5:	Can describe the synthesis methods of synthetic biodegradable polymers	4	–	–	–	H	H	_	H	_	H	–	–	–	–	–	–

UNIT- I: Biopolymers & Biodegradation

Biopolymers: Classification, Biopolymers from natural origin and mineral origin, isolation, properties. Biodegradation: Biodegradable polymer classes, Natural biodegradable polymer, Synthetic biodegradable polymer and modified naturally biodegradable polymer, properties and application. Mechanism of biodegradation (polyesters, polycarbonates, polyvinyl alcohol, polyurethanes and polyether's) factors influencing biodegradation.

UNIT-II: Characterization & Testing for Biodegradability

Test methods and standards for bio-degradable plastics, Criteria used in evaluation of biodegradable plastics, Description of current test methods – Scanning test for ready biodegradability, Test for inherent biodegradability, Test for simulation studies, other methods for assessing polymer biodegradability.

UNIT- III: Structure of Biopolymers

Proteins, nucleic acids and polysaccharides – primary, secondary, tertiary and quaternary structure of polymers – structure maintenance and transmission of the biological information, structure and enzymatic activity – mechano- structural function of biopolymers

UNIT- IV: Biocomposites

Definition- classification- natural bio, fibre and nano fillers as reinforcement, biodegradable/ bio-based resins as matrices. Properties of biocomposites. Applications in automobile & buildings.

UNIT-V: MODULE-V: Applications of Biopolymers and Biocomposites

Biopolymer Films, Biodegradable mulching, Advantages and Disadvantages, Chemical sensors – Biosensors, Functionalized Biopolymer Coatings and Films, Applications of biopolymers in horticulture Food Packaging, Functional Properties, safety and Environmental aspects, Shelf life, Films and coatings in Food Applications, Materials for edible films and coatings, Biopolymer coatings for paper and paperboard, Bio-nanocomposite films and coating. Applications for biocomposites: such as construction materials, vehicles packaging and in medical

.

Learning Resources

Theory:

1. R. Smith, Biodegradable polymers for industrial applications, Woodhead Publishing Ltd, CRC Press, 2005.
2. A.S. Singha and V. K. Thakur,Green Polymer Materials, Studium Press, 2012.
3. A. K.Mohanty, M.Misra and L. T. Drzal,Natural Fibers, Bio Polymers and Bio Composites, CRC Press, 2005.
4. A. J. Domb, J. Kost and D. M. Wiseman, Handbook of Biodegradable polymers, Harwood Academic Publishers, 1997.
5. R. P.Wool, X. S. Sun, Bio-Based Polymers and Composites, Elsevier, 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	20%	-	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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. Samarendramaji, SRMIST
	Dr. Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru Email: kanishka@jncasr.ac.in	1. Prof. M. Arthanareeswari, SRMIST

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Course Code	UPY22G01T	Course Name	*LASER Physics*	Course Category	G	Generic Elective Course	L	T	P	C
							3	0	0	3

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
CLR-1:	*acquire the knowledge on laser beam characteristics*	Bloom's Level
CLR-2:	*acquire knowledge for solving problems in laser physics*	
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:*	Learning
CLO-1:	*understand the basic characteristics of a laser*	4
CLO-2:	*analyse Fabry Perot cavity to understand a laser resonator*	4
CLO-3:	*learn Rate equations to understand the dynamics of a laser*	4
CLO-4:	*understand the conditions of stable resonators*	4
CLO-5:	*acquire knowledge on various types of lasers and the physics of higher harmonic generation*	4

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	ICT Skills	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1:	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-2:	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-3:	-	-	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-4:	-	-	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-5:	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-

Unit-1: General Introduction to lasers, Spontaneous and stimulated emission, Stimulated absorption, The laser idea, Gain medium, pumping scheme and optical feedback, Properties of laser beams: Monochromaticity, Directionality, coherence, Modes of a cavity, Black body radiation, Calculation of mode density, Calculating number of photons per mode for black body, Comparison of black body radiation with laser radiation, Line shape functions, Line-broadening mechanisms, Homogeneous and Inhomogeneous broadening, Natural, Doppler and Collison broadening,

Unit-2: Cavity life time and Quality factor, Ultimate line width of a laser, Einstein's A and B Coefficients, Ratio of A and B at thermal equilibrium, Introduction to resonators, Fabry-Perot cavity, Basic apparatus, Elementary theory of Fabry-Perot cavity, Transmission spectrum of a Fabry-Perot cavity, Coefficient of finesse/Quality factor, Fundamental Gaussian beam, Gaussian beam in homogeneous medium, Gaussian beam focusing, Higher order Gaussian beams, Analysis of higher order Hermite Gauss beams

Unit-3: Geometrical optics analysis of optical resonators, Condition for stable resonators, Stability diagram for optical resonators, Sources of resonator loss, Laser rate equations, Introduction to four level laser system, Mathematical formulation of rate equations for four level laser system, Condition for population inversion, Threshold condition for four level system, Calculating threshold for He-Ne laser, Integrating cavity rate equation, Rate equations under steady state condition, Variation of laser power around the threshold, Optimum output coupling, Laser spiking

Unit-4: Introduction to Q-switching, Dynamics of the Q-switching process, Electro-optical Q-switching, Introduction to mode locking, Mathematical interpretation for mode locking, Passive and active mode locking, Gain saturation, Hole burning, Spatial hole burning, Longitudinal and transverse mode selection, Single mode operation, Multi-mode laser, Gain competition, Optical amplification

Unit-5: Coherence properties of laser light, Temporal coherence, Spatial coherence, Specific laser systems: Ruby laser, He-Ne laser, Carbon dioxide laser, Dye lasers, Semiconductor lasers, DBR lasers, Nd:YAG laser, Higher harmonic generation, Physics of second and third harmonic generations, Classification of lasers and precautions.

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 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%		20%		20%		20%		20%	
Level 2	Understand	20%		20%		20%		20%		20%	
Level 3	Apply	40%		40%		40%		40%		40%	
Level 4	Analyze	20%		20%		20%		20%		20%	
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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
Mr. R Seshadri, Titan Company Limited, seshadri@titan.co.in	*Prof. C Vijayan, IIT Madras, cvijayan@iitm.ac.in*	Dr. Shadak Alee, SRMIST
Dr. N Vijayan, NPL, nvijayan @nplindia.org	*Prof. S Balakumar, University of Madras, balakumar@unom.ac.in*	Dr. Trilochan Sahoo, SRMIST

Course Code	UBT22G01T	Course Name	*Algal Cultivation*	Course Category	G	Generic Elective Course	L	T	P	C
							3	0	0	3

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*impart knowledge about algae*
CLR-2:	*different types of media*
CLR-3:	*cultivation methods*
CLR-4:	*extraction of bioactive compounds*
CLR-5:	*applications of algae*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning (Bloom's Level)	1 Disciplinary Knowledge	2 Critical Thinking	3 Problem Solving	4 Analytical Reasoning	5 Research Skills	6 Team Work	7 Scientific Reasoning	8 Reflective Thinking	9 Self-Directed Learning	10 Multicultural Competence	11 ICT Skills	12 Life Long Learning	13 PSO - 1	14 PSO - 2	15 PSO - 3
CLO-1:	*isolate algae from the environment*	4	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-2:	*select the potential strain*	4	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-3:	*cultivate algae*	4	-	-	-	*H*	*H*	-	-	-	-	-	-	-	-	-	-
CLO-4:	*extract bioactive compounds*	4	-	-	-	*H*	*H*	-	-	-	-	-	-	-	-	-	-
CLO-5:	*produce biodiesel from algae in lab scale*	4	-	-	-	*H*	*H*	-	-	-	-	-	-	-	-	-	-

1. Algal collection methods
2. Algal Isolation techniques
3. Different types of Media
4. Media Preparation
5. Cultivation methods in Lab Scale
6. Harvesting methods and Drying

Learning Resources

1. BARSANTI, LAURA AND PAOLO GUALTIERI 2005 Algae-Anatomy, Biochemistry and Biotechnology. Taylor & Francis, London, New York.
2. BECKER, E.W. 1994 Microalgae-Biotechnology and microbiology. Cambridge University Press.
3. TRIVEDI, P.C. 2001 Algal Biotechnology. Pointer publishers, Jaipur, India.
4. VENKATARAMAN, L.V. AND E.W. BECKER 1985. Biotechnology and Utilization of Algae – The Indian Experience. Dept. Science and Technology, New Delhi and Central Food Research Institute, Mysore, India.

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	20%	-	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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 Higher Technical Institutions	Internal Experts
1. Dr. M. Sujatha, Associate Professor & HOD, Department of Biotechnology, Ethiraj College for Women, Chennai 2. Dr. SUMATHI, Associate Professor, SRMC, Porur, Chennai	Dr. N. Prasanth Bhatt. SRMIST

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Course Code	UMA22G01T	Course Name	*Foundations of Statistics*	Course Category	G	Generic Elective Course	L	T	P	C
							3	0	0	3

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)

CLR-1:	Understand the limitations of statistics
CLR-2:	Employ frequency histogram and polygon
CLR-3:	Introduce the concept of central tendency
CLR-4:	Illustrate the standard deviation and its properties
CLR-5:	Understand the role of rank correlation and repeated ranks.

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Bloom's Level	1 Disciplinary	2 Critical Thinking	3 Problem Solving	4 Analytical Reasoning	5 Research Skills	6 Team Work	7 Scientific Reasoning	8 Reflective Thinking	9 Self-Directed	10 Multicultural	11 ICT Skills	12 Life Long Learning	13 PSO -1	14 PSO -2	15 PSO-3
CLO-1:	Gain an insight on statistical concepts	*4*	*H*		*H*	*H*	*H*	-	-	-	-	-	-	*H*	-	-	-
CLO-2	Be familiar with the Graphical representation of data	*4*	*H*	*H*	*M*	*H*	*H*	-	-	-	-	-	-	*H*	-	-	-
CLO-3:	Understanding Mean, Median and Mode.	*4*	*H*	*H*	*H*	*H*	*M*	-	-	-	-	-	-	*H*	-	-	-
CLO-4:	Analyze thoroughly the measures of dispersion	*4*	*H*	*H*	*M*	*H*	*H*	-	-	-	-	-	-	*M*	-	-	-
CLO-5:	Classify the role of types of correlation	*4*	*M*	*H*	*M*	*L*	*H*	-	-	-	-	-	-	*L*	-	-	-

Unit-1: Statistics – Definition – Primary and secondary data – Limitations of Statistics – Statistical methods.
Unit-2**:** Graphical representation of data – Bar graph – Pie diagram– Classification of data – frequency histogram – Polygon – Ogive curves
Unit-3: Mean – Median – Mode – Properties – Merits – Demerits – graphical method.
Unit-4: Measures of Dispersion – Range - Mean Deviation about mean – Standard Deviation – Properties – Coefficient of variation.
Unit-5: Simple Correlation – Types of Correlation – Rank correlation – Repeated ranks.

Learning Resources	1. Pillai, R.S.N, Bagavathi, V. (2009), Statistics, Theory and Practice, 7th Edition, S. Chand Ltd, New Delhi. 2. Ken Black, (2013), Business Statistics for Contemporary Decision Making, 7th Edition, John Wiley Publications. 3.Gupta, S.P. (2011), Applied Statistical Methods, 4th Edition, Sultan Chand & Sons, New Delhi.	4.Probability and Statistics for Engineers (4th Edition), I.R. Miller,J.E.Freundand R.Johnson, 2015. 5.Fundamentals of Statistics(Vol. I & Vol. II), A. Gun,M. k.GuptaandB.Dasgupta, 2016 6.Lipschutz. S and Schiller. J, "Schaum's outlines - Introduction to Probability and Statistics", McGraw-Hill, New Delhi, 1998

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (100% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)			
		Theory	Practice	Theory	Practice	Theory	Theory	Practice	Theory	Practice	Theory
Level 1	Remember	20%	-	20%	-	20%	20%	-	20%	-	20%
Level 2	Understand	20%	-	20%	-	20%	20%	-	20%	-	20%
Level 3	Apply	40%	-	40%	-	40%	40%	-	40%	-	40%
Level 4	Analyze	20%	-	20%	-	20%	20%	-	20%	-	20%
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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
Mr. Madhan Shanmugasundaram , Director, Infosys Technologies, Chennai	*Prof. Y.V.S.S. Sanyasiraju,* ***IIT Madras,*** sryedida@iitm.ac.in	Dr.B.Vennila, SRMIST

	Prof. B. V. Rathish Kumar, IIT Kanpur, bvrk@iitk.ac.in	*Dr. C. Gunasundari, SRMIST*

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SEMESTER VII

Course Code	*UCY22701T*	Course Name	Electrochemistry and Chemical dynamics	Course Category	C	Core Course	L	T	P	C
							4	0	0	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:	*Describe the ionic conductance in solutions*	
CLR-2	*Acquire knowledge about electrochemical cells and its applications*	
CLR-3	*Understand about the electrical double layer and electrode kinetics*	
CLR-4	Explain the various theories of chemical dynamics	
CLR-5	*Gain knowledge about the reactions in solutions and fast reactions techniques*	

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
			Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Teamwork	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	ICT Skills	Lifelong Learning	PSO -1	PSO -2	PSO-3
CLO-1	*Explain the theory of ionic conductance and measure the ionic activity and activity coefficients*	*4*	*H*	-	-	*H*	*M*	-	-	-	-	-	-	-	-	-	-
CLO-2	*Classify types of electrodes and calculate the EMF of the cells*	*4*	*H*	-	*H*	-	*H*	-	-	-	-	-	-	-	-	-	-
CLO-3	*Illustrate various theory of electrical double layer and describe kinetics of electrode process*	*4*	*H*	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-
CLO-4	*Describe the* various theories of chemical dynamics and interpret the kinetics of chain reactions	*4*	*H*	*H*	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-5	*Demonstrates the influence of ionic strength on rates of reactions in solutions and explains the fast reaction techniques.*	*4*	-	*H*	-	*H*	-	-	*H*	-	-	-	-	-	-	-	-

UNIT- I: Ions in Solutions

Conductivity of solutions and their measurement - the Arrhenius ionisation theory - transport numbers and mobilities of ions - measurement of transport numbers - Hittorff method and moving boundary method - ionic activities and activity coefficients and their determination by various methods - Debye-Huckel-Onsager theory - ionic atmosphere - Debye-Falkenhagen effect-Wien effect-Activity coefficient and mean activity coefficient-Debye-Huckel theory of mean activity of coefficient -Debye-Huckel limiting law - dissociation constant of acids and bases.

UNIT II Electrochemical cell

Galvanic cell- Reversible electrodes- Metal –Metal ion electrodes, gas electrode - Metal – Insoluble metal salt electrode - Oxidation-reduction electrodes - Single electrode Potential - Thermodynamics of reversible cell and electrodes - Determination of ΔG^o, ΔS^o and ΔH^o - Electromotive force and equilibrium constant of a cell- Effect of concentration of electrolyte on cell potential- Standard electrode potential - Electrochemical series - Electromotive force of galvanic cell - Activity and Mean ionic activity of an electrolyte - Concentration cell- Electrode concentration cell - Electrolyte - Concentration cell - Types of electrolyte – concentration cells Without transference, Concentration cell- with transference- Liquid junction Potential - Applications of EMF measurements -Determination of activity coefficient of electrolytes- Determination of Transport number- Valency of Ions in doubtful cases- Determination of the solubility product constants- Determination of pH- using hydrogen electrode- By using quinhydrone electrode- and its limitations.

UNIT III Electrical Double Layer and Electrode Kinetics

Evidence for electrical double layer. Electrocapillary phenomena-Electro capillary curves, Electro-osmosis, electrophoreses. Streaming and Sedimentation potentials. Zeta potentials and its determination by electrophoresis, influence of ions on Zeta potential. Helmholtz-Perrin, Guoy-Chapmann and Stern models of electrical double layer-Applications and limitations.

Kinetics of electrode process. Energy barrier at electrode surface- electrolyte interface, overpotential, Butler – Volmer equation, Tafel equation.

UNIT IV Theories of chemical kinetics

Simple collision theory, absolute reaction rate theory (ARRT), thermodynamic treatment, potential energy surfaces, application of ARRT to simple bimolecular process; chain reactions – general characteristics, study of kinetics of chain reaction like H_2-Br_2 reaction, decomposition of acetaldehyde and N_2O_5, study of H_2- O_2 explosives reactions. Theory of unimolecular reactions-Linedemann, Hinshelwood, RRKM and Slater treatment; steady state approximation, principle of microscopic irreversibility and detailed balancing kinetic isotope effect.

UNIT V Reaction in solution and fast reactions techniques

Comparison between gas phase and solution reactions. Cage effect. The influence of the solvent on the reactions between ions and reaction between ions and neutral molecules. Influence of ionic strength on rates of reactions in solution. ARRT to reaction in solution, Significance of volume and entropy of activation. Primary and secondary salt effect.

Introduction, flow methods (continuous and stopped flow methods) - Relaxation methods (T and P jump methods) – Pulse techniques (pulse radiolysis, flash photolysis, Shock tube method) - molecular beam method – lifetime method.

Learning Resources	**Theory:** 1. K. J. Laidler, "Chemical Kinetics," 2nd Edition, Tata-McGraw Hill, Inc., New York, 1973 2. P. W. Atkins, J. De Paula, Physical Chemistry, 9thEd., Oxford University Press, Oxford, 2010 3. W.J.Moore, Physical Chemistry, Longman Publishing Group, 1998 4. Bockris J.O.M and A.K.N. Reddy, Electrochemistry, volumes 1 and 2 ,Plenum, New york, 1977. **5.** Glasstone.S, An introduction to Electrochemistry Affiliated East West press, New Delhi ,1977.

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	20%	-	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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	Prof. M. Arthanareeswari, SRMIST
	Dr. Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru Email: kanishka@jncasr.ac.in	Dr. J. Arockia Selvi, SRMIST

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Course Code	UCY22702T	Course Name	Analysis of organic molecules	Course Category	C	Core Course	L	T	P	C
							4	0	0	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 knowledge on the basic principle of UV spectroscopy
CLR-2:	enable the students to acquire knowledge on infrared spectroscopy
CLR-3:	acquire knowledge in the fundamentals of mass spectroscopy
CLR-4:	Gain information regarding NMR spectroscopy and analysis
CLR-5:	promote the importance of ESR 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
			Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	ICT Skills	Life Long Learning	PSO -1	PSO -2	PSO-3
CLO-1:	understand the basic concepts of Ultraviolet spectroscopy	4	H											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:	acquaint the fundamental concepts of mass spectroscopy to analyze organic compounds	4	H				M										
CLO-4:	Apply the concepts of NMR spectroscopy to apply on unknown organic compounds	4			H	H											
CLO-5:	utilize their chemistry knowledge of ESR/CD to get in depth knowledge about the prepared compounds.	4				H	H		H		H						

UNIT- I: Ultraviolet spectroscopy

Ultraviolet spectroscopy: Introduction, Interaction of electromagnetic, radiation with matter, Absorption laws, Measurement of the spectrum, chromophores, standard works of reference, Selection rules, electronic transitions in organic compounds and application to structure elucidation, Applications of UV spectroscopy to Conjugated dines, trienes, unsaturated carbonyl compounds and aromatic compounds. Woodward -Fieser rules for the calculation of absorption maxima (λmax) for dienes and carbonyl compounds, Fieser and Kuhn rules, Effects of auxochromes and conjugation on the absorption maxima, Different shifts of absorption peaks (Bathochromic, hypsochromic, hypochromic), Difference in the absorption spectra of organic compounds. Applications in organic molecule analysis.

UNIT- II: Infrared spectroscopy

Infrared spectroscopy: Units of frequency wavelength, wavenumber, molecular vibrations, factors influencing vibrational frequencies, selection rules, The IR spectrometer- Introduction, sampling techniques, characteristic frequencies of organic molecules and interpretation of spectra, Theory of IR spectroscopy, various stretching and vibration modes for diatomic and triatomic molecules (both linear and nonlinear), various ranges of IR (Near, Mid, Finger print and Far) and their usefulness, Instrumentation (Only the sources and detectors used in different regions), sample preparation techniques (Gas, Liquid and solid), Organic functional group identification through IR spectroscopy.

UNIT- III: Mass Spectrometry

Mass Spectroscopy-Basic principles – instrumentation, The mass spectrometer, isotope abundances, the molecular ion, metastable ions, Reactions of ions in gas phase – effect of isotope, nitrogen rule, determination of molecular formula, fragmentations and rearrangements -metastable ions – fragmentation of organic compounds, Instrumentation, various methods of ionization (field ionization, field desorption, FAB, MALDI,) different detectors – magnetic analyser, ion cyclotron analyzer, Quadrupoule mass filter, time of flight (TOF), Rules of fragmentation of different functional, factors controlling fragmentation, HRMS.

UNIT –IV: NMR spectroscopy

NMR spectroscopy: Basic principle, Larmor precession, resonance absorption, magnetic fields, shielding and chemical shifts, chemical equivalence, relaxation processes ,Solution state (1H, 13C), spin-spin coupling AX, AX2 and AXn systems, Paramagnetic shifts and their applications, Instrumentation, chemical shift, calculations of chemical shifts of aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbons, factors affecting chemical shifts, APT, INEPT, DEPT, Homo nuclear (13C-13C) and Hetero nuclear (13C-1H) coupling constants, two dimensional NMR spectroscopy- Correlation spectroscopy (COSY)-Homo COSY (1H-1H), TOCSY, Hetero COSY (HMQC, HMBC), Rules of fragmentation of different functional groups, Homo and Hetero nuclear 2D resolved spectroscopy, NOESY and 2D-INADEQUATE experiments and their applications, basic introduction to solid state NMR.

UNIT - V: ESR spectroscopy and Circular dichroism

Basic principles and applications of ESR spectroscopy to free radicals, molecules and transition metal complexes, Optical rotatory dispersion and circular dichroism: Phenomena of ORD and CD. Classification of ORD, and CD Curves; Cotton effect curves and their application to stereochemical problems, The Octant rule and its application to alicyclic ketones, axial haloketone rule, assignment of configuration of chiral molecules.

Learning Resources	**Theory:** 1. 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, 4thEd., 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	20%	-	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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	Dr. Palash Sanphui, SRMIST
	Dr. Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru Email: kanishka@jncasr.ac.in	Prof. M. Arthanareeswari, SRMIST

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Course Code	UCY22703T	Course Name	Advanced Transition Metal Chemistry and Inorganic Spectroscopy	Course Category	C	Core course	L	T	P	C
							4	0	0	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 basic spectroscopic techniques used in inorganic chemistry	
CLR-2:	Understand the fundamental and importance of electronic and charge transfer spectra	
CLR-3:	Compare the magnetic properties of the complexes against spectroscopic techniques	
CLR-4:	Acquire the trend and features of compounds of lanthanides and actinides.	
CLR-5:	Provide basic understanding about the concepts involved in Electron paramagnetic resonance and Mossbauer 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	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	ICT Skills	Life Long Learning	PSO -1	PSO -2	PSO-3
CLO-1:	Describe the physical and chemical changes that occur at the molecular level in inorganic spectra	4	H	-	H	H	-	-	-	-	-	-	-	-	H	-	-
CLO-2:	Identify different inorganic compounds using electronic and charge transfer spectra	4	H	-	H	H	H	-	-	-	-	-	H	-	-	H	-
CLO-3:	Predict the spectroscopic and magnetic properties of the metal-ligand coordination spheres.	4	-	H	-		-	-	-	-	-	H	-	-	H	M	-
CLO-4:	Appreciate the significance of f-block elements based on their characteristic properties	4	H	H	-	H	-	H	-	-	-	-	-	-	-	M	-
CLO-5:	Analysis of Electron paramagnetic resonance and Mossbauer spectroscopic data for known materials/compounds.	4	-	H	H	H	H	-	-	-	-	-	-	-	-	H	-

Unit-I: Electronic Spectra

Absorption of light: Beer-Lambert absorption law, microstates of electron configuration in free atoms and ions, term symbols for equivalent and nonequivalent electrons, possible term symbols for given configuration, p2-d2 splitting of terms in square planar, tetrahedral, octahedral fields, electronic spectra of various complexes, selection rules-spin and laporte selection rules, spin orbit coupling, assignment and intensities of transitions, correlation diagrams, Orgel (d1 to d9 octahedral and tetrahedral complexes) and Tanabe Sugano diagrams(d1, d6 complexes and its applications), calculation of D0 and b and Racah parameters, Nephelauxetic ratio, examples from d2, d3 d7, d8 octahedral complexes.

Unit-II: Charge-Transfer Spectra and Magnetism

Charge-transfer spectra-ligand-to-metal and metal-to-ligand charge transfer, luminescence, circular dichroism and optical rotatory dispersion, stereochemical information from CD, cooperative magnetism, magnetic properties of tetrahedral and octahedral complexes: para, dia, ferromagnetism and antiferro magnetism, determination of magnetic properties, Gouy's method, anomalous magnetic moment, magnetic susceptibility and the spin-only formula, the effects of temperature on μeff, single molecular magnets, spin and orbital contribution to the magnetic moment, spin cross over rule.

Unit – III: Lanthanides and actinides

Lanthanides: lanthanide series, abundance and natural isotopes, lanthanide contraction, similarity in properties, occurrence, oxidation states, chemical properties of Ln(III) cations, magnetic properties, colour and electronic spectra of lanthanide compounds, separation of lanthanides, solvent extraction, ion exchange, chemical properties of Ln(III) metal ions.

Actinides: actinide series, abundance and natural isotopes, occurrence, preparation of actinides, oxidation states, general properties, the later actinide elements, uranium-occurrence, metallurgy; chemical properties of hydrides, oxides, and halides, complexes of lanthanides and actinides.

Unit – IV: Electron paramagnetic resonance spectroscopy

Theory, analysis of EPR spectra of systems in liquid phase, radicals containing single and multiple set of protons, triplet ground states. EPR spectroscopy of inorganic compounds with unpaired electrons-transition metal ions, rare earth ions, ions in solid state, determination of electronic structure, Zeeman splitting, g-values, hyperfine and super hyperfine coupling constants, practical considerations of measurements, and instrumentation. Double resonance techniques: ENDOR in liquid solution, powders and in non-oriented solids.

Unit – V: Mossbauer spectroscopy
Mossbauer Spectroscopy: Mossebauer effect, recoilless emission and absorption, physical concepts, spectral line shape, chemical isomer shift, quadrupole splitting, magnetic hyperfine interaction and interpretation of spectra, interpretation of Mossbauer parameters of 57Fe and 119Sn, applications to solid-state reactions, thermal decomposition, ligand exchange, electron transfer and isomerism.

Learning Resources	1. Atkins, P.,Overton, T. Shriver and Atkins' inorganic chemistry 6th Ed. Oxford University Press, USA, 2010. 2. Purcell, K.F & Kotz, J.C., Inorganic Chemistry W.B. Saunders Co, 1977. 3. Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993. 4. Brisdon, A. K., Inorganic Spectroscopic Methods, Oxford University Press, 2005. 5. Drago, R. S., Physical Methods in Inorganic Chemistry, East-West Press Pvt. Ltd., 2012. 6. Parrish, R. V., NMR, NQR, EPR and Mossbauer spectroscopy in Inorganic Chemistry, Ellis Horwood Limited, 1990. 7. Ebsworth, E. A. V., et al., Structural Methods in Inorganic Chemistry, 2nd Ed., CRC Press, 1991.

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	20%	-	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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. S. Shanmugan, SRMIST
	Dr. Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru Email: kanishka@jncasr.ac.in	Prof. M. Arthanareeswari, SRMIST

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Course Code	UCY22704T	Course Name	Classical and Statistical Thermodynamics	Course Category	C	Core Course	L	T	P	C
							4	0	0	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 classical thermodynamics.	
CLR-2	Assess the feasibility of a chemical process	
CLR-3	Understand the energetics of mixture of components	
CLR-4	Understand the energy requirements of a chemical reaction or a physical transformation	
CLR-5	Understand the basic concepts of Born-Oppenheimer approximation & Partition function.	

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
			Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Teamwork	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	ICT Skills	Lifelong Learning	PSO -1	PSO -2	PSO-3
CLO-1	Understand the basic principles & concepts of classical thermodynamics.	4	H	-	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-2	Understand the thermodynamic feasibility of a process.	4	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-3	Apply the principles of thermodynamics to the open systems	4	H	-	-	-	M	-	-	-	-	-	-	-	-	-	-
CLO-4	Understand the basic concepts of Born-Oppenheimer approximation & Partition function.	4	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-5	Strengthen the knowledge in solving numerical problems of classical & statistical thermodynamics	4	-	H	-	-	-	-	H	-	-	-	-	-	-	-	-

UNIT- I: First Law of Thermodynamics

Thermodynamic quantities (w, q, ΔU and ΔH) for isothermal and adiabatic reversible expansion of ideal gases, variation of heat of reaction with temperature (Kirchhoff's equation), Joule-Thomson effect, Joule-Thomson coefficient of real (van der Waals) gases.

UNIT-II: Second Law of Thermodynamics

entropy, entropy changes for an ideal gas, entropy changes at constant pressure and volume, entropy change in spontaneous processes, physical significance of entropy, Carnot cycle, free energy and maximum work functions, conditions for spontaneous changes and equilibrium, Maxwell relations, Gibbs-Helmholtz equation, van't Hoff equation, reaction isotherm. Third law of thermodynamics, variation of entropy with temperature, determination of absolute entropy of liquids and gases.

UNIT- III: Thermodynamics of systems of variable composition

Partial molal quantities, chemical potential of a mixture of ideal gases, Gibbs-Duhem equation, chemical potential of real gases and fugacity, activity and activity coefficient, variation of fugacity with temperature and pressure, Lewis-Randall rule, thermodynamic functions of mixing (ΔG_{mix}, ΔS_{mix}, ΔV_{mix}, ΔH_{mix}).

UNIT- IV: Basic Statistical Thermodynamics

Concepts of statistical thermodynamics. Micro canonical, canonical and grand canonical ensembles. Ensemble averages. Most probable distribution. Undetermined multipliers. Fluctuations. Boltzmann statistics, Fermi-Dirac statistics and Bose-Einstein statistics.

UNIT-V: Partition function

Rotational, vibrational, translational, electronic and nuclear partition functions, application of partition functions to specific heat of solids and chemical equilibrium

Learning Resources	Theory:
	1. K. Rajaram and J.C. Kuriacose, Thermodynamics For Students of Chemistry, 2nd Ed., S.L.N. Chand and Co, Jalandhar,1986
	2. P. W. Atkins, J. De Paula, Physical Chemistry, 9thEd., Oxford University Press, Oxford, 2010
	3. . B. R. Puri, L.R. Sharma and M.S. Pathania, Principles of Physical Chemistry, 46th Ed., Vishal Publishing Co., 2014
	4. Statistical Mechanics(1988), B.K. Agarwal and M. Eisner, Wiley Eastern, New Delhi.

	5. Statistical Mechanics(2000), D.A. Mcquarrie, California University Science Books.

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	20%	-	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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	Dr. Srinivasarao Kancharla, SRMIST
	Dr. Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru Email: kanishka@jncasr.ac.in	Dr. J. Arockia Selvi, SRMIST

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Course Code	UCY22S03T	Course Name	Seminar	Course Category	S	Skill Enhancement Course	L	T	P	C
							0	2	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:	Enable the learners to communicate ideas in a succinct and clear manner.	
CLR-2	Produce competent, creative and imaginative graduates with a strong scientific acumen	
CLR-3	expose students to current topics and research in the field of chemistry	
CLR-4	appreciate the components of seminar presentation	
CLR-5	Design a research study to address a specific research question and/or hypotheses.	

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
			Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Teamwork	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	ICT Skills	Lifelong Learning	PSO -1	PSO -2	PSO-3
CLO-1	explain and understand the basic concepts of research	4	H	-	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-2	formulate ideas and present their ideas in the scientific forum	4	-	H			-	-	-	-	-	-	H	-	-	-	-
CLO-3	Construct research work which is logically and professionally presented.	4	-	-	-	-	M	-	M	-	M	-	-	-	-	-	-
CLO-4	gain the confidence to present their work in an open forum	4	-	H	-	-	-	-	-	H	-	-	-	-	-	-	-
CLO-5	Critique and evaluate a research design.	4	-	H	-	-	-	-	H	-	-	-	M	-	-	-	-

Assessment Method – Fully Internal

	Bloom's Level of Thinking	Continuous Learning Assessment (100% weightage)			
		Presentation (70%)		Interaction (30%)	
		Theory	Practice	Theory	Practice
Level 1	Remember	20%	-	20%	-
Level 2	Understand	20%	-	20%	-
Level 3	Apply	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-
Level 5	Evaluate	-	-	-	-
Level 6	Create	-	-	-	-
	Total	100 %		100 %	

Learning Assessment		
	Continuous Learning Assessment (100% weightage)	
	Presentation	Interaction
Seminar	70%	30%
Total	100%	

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Course Code	*UCY22P01L*	Course Name	*Internship*	Course Category	*P*	*Internship/ Project*	L	T	P	C
							0	0	0	3

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)

CLR-1 :	*assist the student's professional skill development useful to employer such as teamwork, communications and work ethics & details*	1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2:	*provide unique learning opportunities by exposing the student to the environment and expectations of professional performance*																
CLR-3:	*expand the student's knowledge of a particular area(s) of interest to enhance employability*																
CLR-4:	*help students to explore career alternatives/opportunities prior to their graduation*																

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	ICT Skills	Life Long Learning	PSO -1	PSO -2	PSO-3
CLO-1:	*demonstrate the skill gained through work experience with mentors or successful professionals to support the early stages of their career*	*4*	H	-	-	-	-	H	-	-	H	-	-	-	-	-	-

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

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Course Code	UCY22P02L	Course Name	Massive Open Online Course	Course Category	P	Internship/ Project	L	T	P	C
							0	0	0	3

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	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 :	encourage initiative by Govt. of India to achieve the three cardinal principles of access, equity and quality in different learning communities.		Level of Thinking (Bloom)	Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	ICT Skills	Life Long Learning	PSO -1	PSO -2	PSO-3
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																	
CLO-1:	demonstrate the knowledge and skill gained through learning of professional/elective courses taken on SWAYAM portal		4	H	-	-	-	-	H	-	-	H	-	-	-	-	-	-
CLO-2:	able to develop the professional skill on the subject areas beyond his curriculum		4	-	-	-	-	-	-	-	-	H	-	M	-	-	-	-
CLO-3:	experience unique and independent learning opportunity		4	H	-	-	-	-	-	-	-	M	-	-	-	-	-	-
CLO-4:	expand his/her knowledge of a particular area(s) of interest to enhance employability		4	-	-	-	-	-	H	-	-	-	-	-	M	-	-	-
CLO-5:	enable the students to have a global connect		4	-	-	-	-	-	H	-	-	M	-	-	-	-	-	-

Learning Assessment	Student shall be allowed to choose one Swayam course on the recommendation of faculty advisor and appropriate credits will be transferred as per regulations 2022
MOOCs	

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Course Code	UCY22AE1T	Course Name	Research Methodology	Course Category	AE	Ability Enhancement Course	L	T	P	C
							3	1	0	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 abstract 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	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	ICT Skills	Life Long Learning	PSO -1	PSO -2	PSO-3
CLO-1 :	Differentiate between various kind of academic writings	4	-	H	-	-	M	-	H	-	-	-	-	-	-	-	-
CLO-2 :	Practice the basic skills of performing quality literature review.	4	-	H	-	-	H	-	-	H	-	-	-	-	-	-	-
CLO-3 :	Target the research work to suitable journal and communicate for publication	4	-	-	-	-	-	-	-	-	H	-	-	M	-	-	-
CLO-4 :	Identify and avoid the plagiarism	4	-	-	-	H	-	-	-	-	H	-	-	-	-	-	-
CLO-5 :	*Develop competence on data collection and process of scientific documentation*	4		H	-	-	-	-	H	-	H	-	-	-	-	-	-

UNIT- I: Academic & research writing
Introduction, Importance of academic writing, Basic rules of academic writing, English in academic writing, Types of academic writing - descriptive, analytical, persuasive and critical.

UNIT-II: Metrics and plagiarism
Plagiarism: Introduction; Tools for the detection of plagiarism; Avoiding plagiarism, Journal Metrics – Types of bibliometric indicators (Generation), Author metrics.

UNIT- III: Literature review and review paper writing
Literature review: Introduction, Source of literature; Process of literature review, Online literature databases; Literature management tools, Review Paper Writing.

UNIT- IV: Research paper and thesis writing
Research paper writing, Referencing and citation, Submission and, Post submission, Thesis Writing, Abbreviations, nomenclature, writing references, Research proposal writing; Abstract/ Conference Paper/ Book/ Book Chapter writing; Open Educational Resources (OERs) for learning & Research.

UNIT-V: Research ethics and intellectual property rights
Challenges in Indian research & writing; Team management (mentor and collaborators), Time Management, Ethics in research – authorship, acknowledgement, competing interest, COPE guidelines, Intellectual property rights – Copy rights and Patent rights.

Learning Resources

Theory:

1. Dawson, C, Practical research methods. UBS Publishers, New Delhi, 2002
2. **Walpole R.A., Myers R.H., Myers S.L.and Ye King: Probablity and statstics for engineers and scientist, Pearson Prentice Hall, Pearson Education, Inc. 2007**
3. **Kothari C.K., Research Methodology-Methods and Techniques (New Age International, New Delhi), 2004**

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	20%	-	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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. T. Pushpa Malini, SRMIST
	Dr. Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru Email: kanishka@jncasr.ac.in	Prof. M. Arthanareeswari, SRMIST

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SEMESTER VIII

Course Code	UCY22P03L	Course Name	Major Project	Course Category	P	Internship/ Project/ Community Outreach	L	T	P	C
							0	0	24	12

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:	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:	Learning Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1 Disciplinary Knowledge	2 Critical Thinking	3 Problem Solving	4 Analytical Reasoning	5 Research Skills	6 Teamwork	7 Scientific Reasoning	8 Reflective Thinking	9 Self-Directed Learning	10 Multicultural Competence	11 ICT Skills	12 Lifelong Learning	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	-	-	-

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

Syllabus for B.S. (Hons.) Chemistry

SEMESTER VI

Course Code	UCY22H01T	Course Name	Advanced Inorganic Chemistry	Course Category	C	Core Course	L	T	P	C
							3	1	0	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 knowledge on the importance of inorganic photochemistry.
CLR-2 :	Understand the principles of photochemistry of organometallic compounds
CLR-3 :	Promote the importance of NMR and NQR spectroscopic applications
CLR-4 :	Acquire in-depth understanding of uses of metals in medicine
CLR-5 :	Understand the importance of characterization of Inorganic 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 Disciplinary Knowledge	2 Critical Thinking	3 Problem Solving	4 Analytical Reasoning	5 Research Skills	6 Team Work	7 Scientific Reasoning	8 Reflective Thinking	9 Self-Directed Learning	10 Multicultural Competence	11 ICT Skills	12 Life Long Learning	13 PSO -1	14 PSO -2	15 PSO-3
CLO-1 :	Understand the basic concepts of inorganic photochemistry.	4	H	-	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-2 :	gain knowledge about the photochemistry of organometallic compounds	4	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-3 :	understand about the importance of 19F, 31P NMR spectroscopy	4	H	-	-	-	M	-	-	-	-	-	-	-	-	-	-
CLO-4 :	apply the inorganic chemistry for medicinal uses	4	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	acquire knowledge about the advanced techniques of inorganic chemistry	4	-	H	-	-	-	-	H	-	-	-	-	-	-	-	-

UNIT- I: Inorganic Photochemistry - I

Basics of Photochemistry: Absorption, excitation, photochemical laws, quantum yield, electronically excited states, life time measurement-Electronic transitions in metal complexes - metal centered and charge transfer transitions - various photophysical and photochemical processes of coordination compounds - unimolecular charge-transfer photochemistry of cobalt(III) complexes - mechanism of CTTM photoreduction. Ligand field photochemistry of Cr(III) complexes - Adamson's rule - photoactive excited states - V-C model - photophysics and photochemistry of Ru-polypyridine complexes.

UNIT-II: Inorganic Photochemistry - II

photochemistry of organometallic compounds - metal-carbonyl compounds - compounds with metal-metal bonding - Metal complex sensitizer: electron relay, metal colloid systems, semiconductor supported metal or oxide systems, water photolysis, nitrogen fixation and carbon dioxide reduction. chemical actinometer: Ferrioxalate actinometer , Photochromic actinometer , Reinecke's salt actinometer.

UNIT- III: Advanced Spectroscopy for Inorganic Compounds

Concept of nuclear spin and resonance, fundamentals of coupling (homonuclear heteronuclear) and decoupling, coupling constants. Effect of natural abundance. Principle of NMR (^{19}F, ^{31}P and ^{13}C) techniques to characterize the inorganic compounds, Chemical shifts-application of spin-spin coupling to structure determination-H_3PO_3 and H_3PO_2, P_4S_3, BrF_5, PF_3R_2 type compounds. NQR spectroscopy: Characteristics of quadrupolar nucleus – effects of field gradient and magnetic field upon quadrupolar energy levels-NQR transitions – applications of NQR spectroscopy.

UNIT- IV: Inorganic Medicinal Chemistry

Metal Toxicity and Homeostasis, Metal complexes in medicine – Platinum complexes in cancer therapy: Cisplatin and its mode of action, Ruthenium anticancer active complexes - Technetium and Indium radiopharmaceuticals- Gadolinium MRI Imaging Agents- Vanadium-Based Diabetes Drugs-Silver antimicrobial drugs.

UNIT-V: Advanced Techniques in Inorganic chemistry

Atomic X-Ray spectroscopy - Fundamental principle and Instrument component, Electron spectroscopy for chemical analysis (ESCA), Auger Emission spectroscopy (AES), Principle and Applications of ICP atomic Fluorescence spectroscopy, Quantitative applications of ICP-MS, Secondary Ion Mass Spectrometry (SIMS), Ion Microprobe Mass Analyzer (IMMA), Applications of circular dichroism to inorganic compounds.

Learning Resources	**Theory:** 6. J.Ferraudi, "Elements of Inorganic Photochemistry" , Wiley, New York, 1988. 7. A. W. Adamson and P. D. Fleischauer, "Concepts of Inorganic Photochemistry, Wiley, New York, 1975. 8. R.S. Drago, Physical methods inorganic chemistry, 3rd ed., Wiley Eastern Company. 9. R.S. Drago, Physical Methods in chemistry, W. B. Saunders Company, Philadelphia, London. 4. 10. Bioinorganic chemistry, R. W. Hay, Halsted Press, 1984. 11. Principles of Bioinorganic Chemistry, S. J. Lippard and J.M. Berg, Panima Publishing Corporation, 2nd Ed., 1995 12. Organic and Inorganic Photochemistry, V. Ramamurthy, CRC Press, 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	20%	-	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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: gsekar@iitm.ac.in	Dr. M. Ganesh Pandian, SRM IST
Dr. Ravikiran Allada, Head R&D, Analytical, Novugen Pharma, Malaysia Email: ravianalytical@gmail.com	Dr. Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru Email: kanishka@jncasr.ac.in	Prof. M. Arthanareeswari, SRMIST

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SEMESTER VII

Course Code	UCY22H02T	Course Name	Advanced Organic Chemistry	Course Category	C	Core Course	L	T	P	C
							3	1	0	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 alkaloids and terpenoids	
CLR-2 :	acquire knowledge about Amino Acids, Peptides and Proteins	
CLR-3 :	promote the importance of Purines, Pyrimidines and Steroids	
CLR-4 :	understand the synthesis and uses of Carbohydrates	
CLR-5 :	acquire basic understanding of photochemistry	

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
			Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	ICT Skills	Life Long Learning	PSO -1	PSO -2	PSO-3
CLO-1 :	understand the basic concepts of natural products	4	H	-	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-2 :	gain the importance about alkaloids and terpinoids	4	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-3 :	understand about the importance of amino acids, proteins	4	H	-	-	-	M	-	-	-	-	-	-	-	-	-	-
CLO-4 :	To synthesize carbohydrate in the laboratory	4	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	gain basic understanding of photosynthesis	4	-	H	-	-	-	-	H	-	-	-	-	-	-	-	-

UNIT- I: Alkaloids and terpenoids

Natural occurrence, General structural features, Isolation and their physiological action, Hoffmann's exhaustive methylation, Emde's modification, Structure elucidation and synthesis of Hygrine and Nicotine. Medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine. Terpenes Occurrence, classification, isoprene rule; Elucidation of stucture and synthesis of Citral, Neral and α-terpineol.

UNIT-II: Amino Acids, Peptides and Proteins

Preparation of Amino Acids: Strecker synthesis using Gabriel's phthalimide synthesis. Zwitterion, Isoelectric point and Electrophoresis. Reactions of Amino acids: ester of –COOH group, acetylation of –NH 2 group, complexation with Cu^{2+} ions, ninhydrin test. Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins. Determination of Primary structure of Peptides by degradation Edmann degradation (N-terminal) and C–terminal (thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) & C-activating groups and Merrifield solid-phase synthesis.

UNIT- III: Purines, Pyrimidines and Steroids

Purines: Introduction, biological importance, Synthesis and structural elucidation of Uric acid, Xanthine, Caffeine and Theophylline. Nucleobases: adenine, guanine, cytosine, thymine, uracils, DNA, RNA structures and replication. Steroids: Introduction, stereochemistry and nomenclature. Structural determination and synthesis of cholesterol. Synthesis of (±)-oestrone. Occurrence and isolation of purines. Classification and spectral properties of steroids.

UNIT- IV: Carbohydrates

Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, mutarotation, ascending and descending in monosaccharides. Structure of disacharrides (sucrose, cellobiose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation

UNIT-V: Photochemistry

Absorption of light by organic molecules, Jablonski diagram, properties of excited states, mechanism of excited state processes and methods of preparative photochemistry, photochemistry of alkenes and related compounds: isomerization, Di-π-methane rearrangement, and cycloadditions, photochemistry of aromatic compounds: ring isomerization and cyclization reactions, photochemistry of carbonyl compounds: Norrish type-I cleavage of acyclic, cyclic, and unsaturated carbonyl compounds, Norrish type-II cleavage, hydrogen abstraction: intramolecular and intermolecular hydrogen abstraction, photoenolization, photocyclo-addition of ketones with unsaturated compounds: Paterno-Buchi reaction, Barton reaction, photodimerisation of α, β- unsaturated ketones, rearrangement of enones and dienones, photo-Fries rearrangement.

Learning Resources	**Theory:**
	1.O. P. Agarwal, Chemistry of Natural Products, Vol-1, Goel Publishing House, 1997.
	2. Gurdeep Chatwal and Anand, Chemistry of Natural Products, Himalayan Publishing Co, 2001.
	3. I. L. Finar, Organic Chemistry, Volume II, 5th Ed., ISBN: 9788177585414, 9788177585414.

	4.R. H. Thomson, Chemistry Of Natural Products, 2nd Edition, Springer publication, ISBN-10 : 8181288637 **5.J. Clayden, N. Greeves, S. Warren and P. Wothers, Organic Chemistry, 1st Ed., Oxford University Press, 2001.** **6.M.B. Smith & J.March, March's Advanced Organic Chemistry, 5th Ed., John Wiley & Sons, New York, 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	20%	-	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	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, Head R&D, Analytical, Novugen Pharma, Malaysia Email: ravianalytical@gmail.com	Prof. G. Sekar, Department of Chemistry, IIT Madras Email: gsekar@iitm.ac.in	Dr. Palash Sanphui, SRMIST
	Dr. Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru Email: kanishka@jncasr.ac.in	Prof. M. Arthanareeswari, SRMIST

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Course Code	UCY22H03T	Course Name	Advanced Physical Chemistry	Course Category	C	Core Course	L	T	P	C
							3	1	0	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 various spectroscopic methods based on the magnetic resonance principles	
CLR-2	learn principles EPR spectroscopy to analyze radical nature of a sample	
CLR-3	Acquire knowledge about the application of Quantum mechanical principles to many electrons system	
CLR-4	Understand the application of quantum mechanical principles to chemical bonding	
CLR-5	Understand the application of Group theory in energy calculation and 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	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	ICT Skills	Life Long Learning	PSO -1	PSO -2	PSO-3
CLO-1	Analyze spectroscopic information to obtain structural information of molecules	4	H	-	-	H	H	-	-	-	-	-	-	-	-	-	-
CLO-2	Analyze spectroscopic information to obtain chemical bonding and radical nature of molecules	4	H	-	-	-	H		M	-	-	-	-	-	-	-	-
CLO-3	Apply quantum mechanical principles to atomic structure of many electrons system	4	-	H	H	-	-	-	H	-	-	-	-	-	-	-	-
CLO-4	Apply quantum mechanical principles to chemical bonding theories of molecules	4	-	H	H	-	-	-	H	-	-	-	-	-	-	-	-
CLO-5	Solve for energy and possible electronic transition of molecules concepts of Group theory	4	-	H	H	-	H	-	-	-	-	-	-	-	-	-	-

UNIT I NMR Spectroscopy
Magnetic resonance: A review of spin angular momentum, basic principles and relaxation times, intensity of NMR signals, electronic shielding, NMR in liquids: chemical shifts, spin-spin couplings, NMR spectra of AX, A3X and AB systems.

UNIT II ESR Spectroscopy
Relaxation processes. Origin of g-shifts and hyperfine coupling. Negative spin densities. Experimental determination of g, A and D tensors-their interpretation with examples

UNIT III Quantum mechanics application to Atomic Structure
Approximation methods -Perturbation Theory (first order and non-degenerate) The Variation method, linear variation principle, Helium -Space quantisation – electron spin – Many electron atoms – one electron orbitals – Pauli principle – determinantal form of wave function (Slater determinants), Helium atom- Hartree-Fock self-consistent field method.

UNIT IV Quantum mechanics application to chemical bonding
The Born Oppenheimer approximation, the molecular orbital (MO) theory, LCAO-MO approximation -H_2^+ , H_2 molecules -VB treatment of diatomic molecules - Huckel molecular theory (HMO) for simple π-electron systems

UNIT V Applications of Group theory
Symmetry aspects of molecular orbital theory, planar π-systems, symmetry factoring of Huckel determinants, solving it for energy and MOs for ethylene and 1,4-butadiene- electronic spectra, selection rule, polarization electron dipole transition, electronic transitions in formaldehyde, butadiene.

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. D.A. Mcquarrie, Quantum Chemistry, University Science Books, 1983.
4. Ira.N. Levine, Quantum Chemistry,7th edition, Allyn and Bacon, 1983.
5. P. W. Atkins, J. De Paula, Physical Chemistry, 9thEd., Oxford University Press, Oxford, 2010

	6. Cotton F. A, Chemical applications of group theory, 3rd edition, John Wiley& Sons, 2004 **7.** G.Davidson, Introduction to Group Theory for Chemist, Applied Science Publishers Ltd., London (1971). **8.** K.V.Raman, Group Theory and its Application in Chemistry, Tata McGrew-Hill, (1990). **9.** V.Ramakrishnan and Gopinath, Group Theory in Chemistry, 2nd edn., Vishal Publications, 1991. 10. **Molecular Spectra & Molecular Structure. G. Herzberg, Van Nostrand Reinhold Company** 11. **Molecular Spectroscopy. I. N. Levine, Wiley –Interscience Publication**

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	20%	-	20%	-	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-	20%	-	20%	-
Level 3	Apply	40%	-	40%	-	40%	-	40%	-	40%	-
Level 4	Analyze	20%	-	20%	-	20%	-	20%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-	-	-	-	-
Level 6	Create	-	-	-	-	-	-	-	-	-	-
	Total	100 %		100 %		100 %		100 %		100 %	

Course Designers

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