ACADEMIC CURRICULA

UNDERGRADUATE DEGREE PROGRAMME

Bachelor of Science in
Physics
Three Years /

Bachelor of Science (Honours) in
Physics
Four Years

Learning Outcomes Based Curriculum Framework (LOCF)

Choice Based Flexible Credit System

Academic Year
2023-2024

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 recognized nationally and internationally as an exemplary department of physics
Stmt - 2	To provide core instruction in pure and applied physics to train new generation of leading physicists
Stmt - 3	To emerge as a hub of world class research to disseminate our knowledge through interaction with industry, academia and society at large

2.	Department Mission Statement
Stmt - 1	To provide world class teaching and state of art research environment to highly talented young minds
Stmt - 2	To perform frontier research in pure and applied physics, and to serve the society through technological advances
Stmt - 3	To provide an outstanding educational and research experience for the students, researchers and technologists
Stmt - 4	To enable the students to have wide range of career choices through outstanding learning experience
Stmt - 5	To infuse best scientific methods in teaching theoretical and experimental concepts of physics

3.	Program Education Objectives (PEO)
PEO - 1	*Acquiring knowledge and skill:* Understanding the basics of various fields of Physics ranging from fundamental core subjects to application based subjects
PEO - 2	*Higher studies/research/analysis:* To employ critical thinking, analytical Problem Solving Skills in the basic areas of Physics
PEO - 3	*Job orientations/proficiency /skills:* Capable of working effectively in diverse teams in both class-room and laboratory experiments to identify appropriate resources required for management and completion of project with ethical scientific conduct
PEO - 4	*Entrepreneurship/Self-empowerment:* To emphasize the relevance of Physics as the important discipline for sustaining the existing industries and establishing new ones, to self-empower the students to create job opportunities and entrepreneurships
PEO - 5	*Social/National Relevance*: To develop a national and international perspective in core and applied Physics to enable them for improving knowledge and skill for their career development in the chosen field of Physics

4.	Program Specific Outcomes (PSO)
PSO - 1	Graduates will acquire a comprehensive knowledge and sound understanding of fundamentals of Physics
PSO - 2	Graduates will develop practical, analytical and mathematical skills to solve problems in Physics and related desciplines
PSO - 3	Graduates will acquire a range of technical skills: to evaluate information, to use computers productively, to communicate with society effectively, and to learn and research independently

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	H	H	H	H	H
PEO - 3	H	M	M	H	M
PEO - 4	H	M	H	H	M
PEO - 5	H	H	H	H	H

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

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.*
	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	ICT Skills	Professional Behavior	Life Long Learning
PEO - 1	H	H	M	M	H	H	H	H	H	H	M	H	H	M	H
PEO - 2	H	H	H	H	M	H	M	M	H	H	H	H	H	L	H
PEO - 3	M	M	M	M	H	H	H	H	H	H	H	H	H	H	H
PEO - 4	H	H	H	H	H	H	H	H	H	H	M	H	H	H	M
PEO - 5	H	H	H	L	H	H	H	H	H	H	H	H	H	H	H

7. Programme Structure

1. Discipline Specific Core Courses (C)
(20 Courses)

Course Code	Course Title	Hours/ Week				C
		L	T	P	O	
UPY23101J	Mathematical Physics-I	3	0	2	2	4
UPY23102J	Classical Mechanics-I	3	0	2	2	4
UPY23103J	Properties of Matter and Acoustics	3	0	3	2	4
UPY23201J	Electricity and Magnetism	3	0	3	2	4
UPY23202J	Mathematical Physics-II	3	0	2	2	4
UPY23203J	Heat and Thermodynamics	3	0	3	2	4
UPY23301J	Classical Mechanics-II	3	0	2	2	4
UPY23302J	Statistical Mechanics	3	0	2	2	4
UPY23303J	Computational Physics	3	0	3	2	4
UPY23401J	Quantum Mechanics-I	3	0	2	2	4
UPY23402J	Solid State Physics	3	0	3	2	4
UPY23403J	Electronics	3	0	3	2	4
UPY23501J	Quantum Mechanics-II	3	0	2	2	4
UPY23502J	Optics	3	0	3	2	4
UPY23503J	Advanced Electronics	3	0	3	2	4
UPY23601J	Electromagnetics and Applications	3	0	2	2	4
UPY23602J	Atomic and Molecular Spectroscopy	3	0	2	2	4
UPY23603T	Research Methodology	4	0	0	2	4
UPY23701L	Advanced Lab	0	0	8	2	4
UPY23801J	Nuclear and Particle Physics	3	0	2	2	4
	Total Learning Credits					**80**

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

Course Code	Course Title	Hours/ Week				C
		L	T	P	O	
UPY23D01J	Sensors and Detectors	3	0	2	2	4
UPY23D02J	Biophysics					
UPY23D03J	Physics of Nanomaterials	3	0	2	2	4
UPY23D04J	Astrophysics					
UPY23D05J	Advanced Computational Physics	3	0	2	2	4
UPY23D06J	Quantum Optics					
UPY23D07T	Energy Storage and Devices	3	1	0	2	4
UPY23D08T	Atmospheric Science					
UPY23D09J	Symmetries and Fields	3	0	2	2	4
UPY23D10J	Advanced Condensed Matter Physics					
	Total Learning Credits					**20**

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

Course Code	Course Title	Hours/ Week				C
		L	T	P	O	
ULT23G01J	Tamil-I	2	0	2	2	3
ULH23G01J	Hindi-I	2	0	2	2	
ULF23G01J	French-I	2	0	2	2	
ULT23G02J	Tamil-II	2	0	2	2	3
ULH23G02J	Hindi-II	2	0	2	2	
ULF23G02J	French-II	3	0	0	2	
UPY23G01J	Allied Physics	3	0	3	2	4
UPY23G02T	Laser Physics	3	1	0	2	
UCY23G01J	Basic Chemistry	3	0	3	2	
UPY23G03T	Data, Statistics, and Inference	3	0	2	2	4
UMA23G11T	Allied Mathematics	3	1	0	2	
UPY23G04T	Solar Technology	3	1	0	2	4
UCY23G02T	Polymer chemistry and its uses	3	1	0	2	
UPY23G05T	Structure and Properties of Materials	3	1	0	2	4
UCY23G03T	Food Chemistry	3	1	0	2	
UPY23G06T	Thin Films	4	0	0	2	4
UCY23G04T	Pharmaceutical Chemistry	3	1	0	2	
UPY23G07T	Group Theory	3	1	0	2	4
UCY23G05T	Chemistry in everyday life	3	1	0	2	
UPY23G08T	Applications of Nanotechnology	3	1	0	2	4
UCY23G06T	Computational Modelling in Chemistry	3	1	0	2	
	Total Learning Credits					***34***

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

Course Code	Course Title	Hours/ Week				C
		L	T	P	O	
UCD23S01L	Quantitative Aptitude and Logical Reasoning	0	0	2	2	1
UCD23S02T	Verbal Ability and Skill Development	2	0	0	2	2
UPY23S01L	Workshop Practice	0	0	2	2	1
UPY23S02T	Python Programming	0	2	0	2	2
UPY23S03L	Microprocessor & Microcontrollers	0	0	2	2	1
	Total Learning Credits					**7**

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

7. Internship/Apprenticeship / Project/ Community Outreach (IAPC) *(4 Courses)*						
Course	Course	Hours/ Week				
Code	Title	L	T	P	O	C
UPY23P01L	*Internship - I*	*0*	*0*	*0*	*0*	*1*
UPY23P02L	*Internship - II*	*0*	*0*	*0*	*0*	*1*
UPY23P03L	*Mini Project*	*0*	*0*	*4*	*2*	*2*
UPY23P04L	*Internship - III*	*0*	*0*	*0*	*0*	*2*
UPY23P05L	*Project Phase-I*	*0*	*0*	*8*	*2*	*4*
UPY23P06L	*Project Phase-II*	*0*	*0*	*12*	*2*	*6*
	Total Learning Credits					16

6. Value Addition Course (V) *(4 Courses)*						
Course Code	***Course Title***	***Hours/ Week***				***C***
		L	***T***	***P***	***O***	
UCD23V01T	*Universal Human Values*	*2*	*0*	*0*	*2*	*2*
UEN23V01L	*Communication Skills*	*0*	*0*	*4*	*2*	*2*
UCD23V02T	*Industry Oriented Employability Skills for Science*	*2*	*0*	*0*	*2*	*2*
UCD23V05T	*Career Readiness and Professional Skills*	*2*	*0*	*0*	*2*	*2*
	Total Learning Credits					***8***

8.Mandatory Courses (M) *(2 Courses)*						
Course Code	*Course Title*	***Hours/ Week***				*C*
		L	***T***	***P***	***O***	
UNS23M01L	*NSS*	*0*	*0*	*0*		*0*
UNC23M01L	*NCC*					
UNO23M01L	*NSO*					
UYG23M01L	*YOGA*					
UMI23M01L	*My India Project*					0
	Total Learning Credits					***0***

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8. Implementation Plan

Semester I

Course Code	Course Title	Hours/ Week				C
		L	T	P	O	
ULT23G01J	*Tamil-I*	*2*	*0*	*2*	*2*	*3*
ULH23G01J	*Hindi-I*					
ULF23G01J	*French-I*					
ULE23AE1T	*English*	*4*	*0*	*0*	*2*	*4*
UPY23101J	*Mathematical Physics-I*	*3*	*0*	*2*	*2*	*4*
UPY23102J	*Classical Mechanics-I*	*3*	*0*	*2*	*2*	*4*
UPY23103J	*Properties of Matter and Acoustics*	*3*	*0*	*3*	*2*	*4*
UCD23S01L	*Quantitative Aptitude and Logical Reasoning*	*0*	*0*	*2*	*2*	*1*
UCD23V01T	*Universal Human Values*	*2*	*0*	*0*	*2*	*2*
Total Learning Credits						22
	Total number of hours/Week					28

Semester II

Course Code	Course Title	Hours/ Week				C
		L	T	P	O	
ULT23G02J	*Tamil-II*	*2*	*0*	*2*	*2*	*3*
ULH23G02J	*Hindi-II*					
ULF23G02J	*French-II*					
UES23AE1T	*Environmental Studies*	*3*	*0*	*0*	*2*	*3*
UPY23201J	*Electricity and Magnetism*	*3*	*0*	*3*	*2*	*4*
UPY23202J	*Mathematical Physics-II*	*3*	*0*	*2*	*2*	*4*
UPY23203J	*Heat and Thermodynamics*	*3*	*0*	*3*	*2*	*4*
UCD23S02T	*Verbal Ability and Skill Development*	*2*	*0*	*0*	*2*	*2*
UEN23V01L	*Communication Skills*	*0*	*0*	*4*	*2*	*2*
UNS23M01L	*NSS*	*0*	*0*	*0*	*0*	*0*
UNC23M01L	*NCC*					
UNO23M01L	*NSO*					
UYG23M01L	*YOGA*					
Total Learning Credits						22
Total number of hours/Week						30

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Semester III

Course Code	Course Title	Hours/ Week				C
		L	T	P	O	
UPY23301J	Classical Mechanics-II	3	0	2	2	4
UPY23302J	Statistical Mechanics	3	0	2	2	4
UPY23303J	Computational Physics	3	0	3	2	4
ULT23AE1J	Applied Tamil – I	1	0	2	2	2
ULH23AE1J	Applied Hindi - I					
ULF23AE1J	French for specific purpose-I					
UCY23G01J	Basic Chemistry	3	0	3	2	4
UPY23G02T	Laser Physics	3	1	0	2	
UPY23S01L	Workshop Practice	0	0	2	2	1
UPY23P01L	Internship - I	0	0	0	0	1
UCD23V02T	Industry Oriented Employbility Skills for Science	2	0	0	2	2
Total Learning Credits						22
Total number of hours/Week						29

Semester IV

Course Code	Course Title	Hours/ Week				C
		L	T	P	O	
UPY23401J	Quantum Mechanics-I	3	0	2	2	4
UPY23402J	Solid State Physics	3	0	3	2	4
UPY23403J	Electronics	3	0	3	2	4
ULT23AE2J	Applied Tamil – II	1	0	2	2	2
ULH23AE2J	Applied Hindi - II					
ULF23AE2J	French for specific purpose-II					
UPY23G03T	Data, Statistics, and Inference	3	1	0	2	4
UMA23G11T	Allied Mathematics					
UPY23S02T	Python Programming	0	2	0	2	2
UCD23V05T	Career Readiness and Professional Skills	2	0	0	2	2
UMI23M01L	My India Project					0
Total Learning Credits						22
Total number of hours/Week						28

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Semester V

Course Code	Course Title	Hours/ Week				C
		L	T	P	O	
UPY23501J	*Quantum Mechanics-II*	*3*	*0*	*2*	*2*	*4*
UPY23502J	*Optics*	*3*	*0*	*3*	*2*	*4*
UPY23503J	*Advanced Electronics*	*3*	*0*	*3*	*2*	*4*
UPY23D01J	*Sensors and Detectors*	*3*	*0*	*2*	*2*	*4*
UPY23D02J	*Biophysics*					
UPY23G04T	*Solar Technology*	*3*	*1*	*0*	*2*	*4*
UCY23G02T	*Polymer chemistry and its uses*					
UPY23S03L	*Microprocessor & Microcontrollers*	*0*	*0*	*2*	*2*	*1*
UPY23P02L	*Internship - II*	*0*	*0*	*0*	*0*	*1*
Total Learning Credits						22
Total number of hours/Week						28

Semester VI

Course Code	Course Title	Hours/ Week				C
		L	T	P	O	
UPY23601J	*Electromagnetics and Applications*	*3*	*0*	*2*	*2*	*4*
UPY23602J	*Atomic and Molecular Spectroscopy*	*3*	*0*	*2*	*2*	*4*
UPY23603T	*Research Methodology*	*4*	*0*	*0*	*2*	*4*
UPY23D03J	*Physics of Nanomaterials*	*3*	*0*	*2*	*2*	*4*
UPY23D04J	*Astrophysics*					
UPY23G05T	*Structure and Properties of Materials*	*3*	*1*	*0*	*2*	*4*
UCY23G03T	*Food Chemistry*					
UPY23P03L	*Mini Project*	*0*	*0*	*4*	*2*	*2*
Total Learning Credits						22
Total number of hours/Week						27

Total number of learning credits	**132**

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Semester VII

Course Code	Course Title	Hours/ Week				C
		L	T	P	O	
UPY23701L	*Advanced Laboratory*	*0*	*0*	*8*	*2*	*4*
UPY23D05J	*Advanced Computational Physics*	*3*	*0*	*2*	*2*	*4*
UPY23D06J	*Quantum Optics*					
UPY23G06T	*Thin Films*	*4*	*0*	*0*	*2*	*4*
UCY23G04T	*Pharmaceutical Chemistry*	*3*	*1*	*0*	*2*	
UPY23G07T	*Group Theory*	*3*	*1*	*0*	*2*	*4*
UCY23G05T	*Chemistry in everyday life*					
UPY23P04L	*Internship - III*	*0*	*0*	*0*	*0*	*2*
UPY23P05L	*Project Phase-I*	*0*	*0*	*8*	*2*	*4*
Total Learning Credits						22
Total number of hours/Week						29

Semester VIII

Course Code	Course Title	Hours/ Week				
		L	T	P	O	C
UPY23801J	*Nuclear and Particle Physics*	*3*	*0*	*2*	*2*	*4*
UPY23D07T	*Energy Storage and Devices*	*3*	*1*	*0*	*2*	*4*
UPY23D08T	*Atmospheric Science*					
UPY23D09J	*Symmetries and Fields*	*3*	*0*	*2*	*2*	*4*
UPY23D10J	*Advanced Condensed Matter Physics*					
UPY23G08T	*Applications of Nanotechnology*	*3*	*1*	*0*	*2*	*4*
UCY23G06T	*Computational Modelling in Chemistry*					
UPY23P06L	*Project Phase-II*	*0*	*0*	*12*	*2*	*6*
Total Learning Credits						22
Total number of hours/Week						30

Total number of learning credits	**176**

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Courses for earning Additional Credits

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

Note : Those students **who decide to exit** at the end of the First year shall register for any one of the courses mentioned under Semester – II; and decide to exit at the end of the Second year shall register for any one of the courses mentioned under Semester – IV in the above list.

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9. Program Articulation Matrix

Course Code	Course Name	Programme Learning Outcomes														
		Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	ICT Skills	Professional Behavior	Life Long Learning
UPY23101J	*Mathematical Physics-I*	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
UPY23102J	*Classical Mechanics-I*	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
UPY23103J	*Properties of matter and acoustics*	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
UPY23201J	*Electricity and Magnetism*	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
UPY23202J	*Mathematical Physics-II*	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
UPY23203J	*Heat and Thermodynamics*	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
UPY23301J	*Classical Mechanics-II*	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
UPY23302J	*Statistical Mechancis*	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
UPY23303J	*Computational Physics*	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
UPY23401J	*Quantum Mechanics-I*	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
UPY23402J	*Solid State Physics*	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
UPY23403J	*Electronics*	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
UPY25101J	*Quantum Mechanics-II*	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
UPY23502J	*Optics*	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
UPY23503J	*Advanced Electronics*	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
UPY23601J	*Electromagnetics and Applications*	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
UPY23602J	*Atomic and Molecular Spectroscopy*	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
UPY23603J	*Research Methodology*	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
UPY23701L	*Advanced Lab*	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
UPY23801J	*Nuclear and Particle Physics*	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
UPY23D01J	*Sensors and Detectors*	H	-	H	-	-	-	-	-	-	H	-	-	-	-	-
UPY23D02J	*Biophysics*	H	-	-	H	-	-	-	-	-	-	-	H	-	-	-
UPY23D03J	*Physics of Nanomaterials*	H	-	H	-	-	-	-	-	-	H	-	-	-	-	-
UPY23D04J	*Astrophysics*	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
UPY23D05J	*Advanced Computational Physics*	H	-	H	-	-	-	-	-	-	H	-	-	-	-	-
UPY23D06J	*Quantum Optics*	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
UPY23D07T	*Energy Storage and Devices*	H	-	H	-	-	-	-	-	-	H	-	-	-	-	-
UPY23D08T	*Atmospheric Science*	H	-	H	-	-	-	-	-	-	H	-	-	-	-	-
UPY23D09J	*Symmetries and Fields*	H	-	H	-	-	-	-	-	-	H	-	-	-	-	-
UPY23D10J	*Advanced Condensed Matter Physics*	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
ULT23G01J	*Tamil-I*	H	-	H	-	H	H	-	M	H	-	H	H	-	-	-
ULH23G01J	*Hindi-I*	H	-	H	-	H	H	-	M	H	-	H	H	-	-	-
ULF23G01J	*French-I*	H	-	H	-	H	H	-	M	H	-	H	H	-	-	-
ULT23G02J	*Tamil-II*	H	-	H	-	H	H	-	M	H	-	H	H	-	-	-
ULH23G02J	*Hindi-II*	H	-	H	-	H	H	-	M	H	-	H	H	-	-	-
ULF23G02J	*French-II*	H	-	H	-	H	H	-	M	H	-	H	H	-	-	-
UPY23G01J	*Allied Physics*	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
UPY23G02T	*Laser Physics*	H	-	H	-	-	-	-	-	-	H	-	-	-	-	-
UPY23G03T	*Data, Statistics, and Inference*	H	-	-	H	-	-	-	-	-	-	-	H	-	-	-
UPY23G04T	*Solar Technology*	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
UPY23G05T	*Structure and Properties of Materials*	H	-	H	-	-	-	-	-	-	H	-	-	-	-	-
UPY23G06T	*Thin Films*	H	-	-	H	-	-	-	-	-	-	-	H	-	-	-
UPY23G07T	*Group theory*	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
UPY23G08T	*Applications of Nanotechnology*	H	-	H	-	-	-	-	-	-	H	-	-	-	-	-
UCD23S01L	*Quantitative Aptitude and Logical Reasoning*	H	M	M	L	-	M	-	M	H	L	H	L	-	-	-
UCD23S02T	*Verbal Ability and Skill Development*	H	M	M	L	-	M	-	M	H	L	H	L	-	-	-
UPY23S01L	*Workshop Practice*	-	H	-	-	-	-	-	-	-	H	-	-	-	-	H
UPY23S02T	*Python Programming*	H	-	H	-	-	-	-	-	-	H	-	-	-	-	-
UPY23S03L	*Microprocessor & Microcontrollers*	H	H	-	H	-	-	-	-	-	-	-	H	-	-	-
ULE23AE1T	*English*	H	-	H	-	H	H	-	M	H	-	H	H	-	-	-

ULT23AE1J	*Applied Tamil – I*	H	-	H	-	H	H	-	M	H	-	H	H	-	-	-
ULH23AE1J	*Applied Hindi - I*	H	-	H	-	H	H	-	M	H	-	H	H	-	-	-
ULF23AE1J	*French for specific purpose-I*	H	-	H	-	H	H	-	M	H	-	H	H	-	-	-
ULT23AE2J	*Applied Tamil – II*	H	-	H	-	H	H	-	M	H	-	H	H	-	-	-
ULH23AE2J	*Applied Hindi - II*	H	-	H	-	H	H	-	M	H	-	H	H	-	-	-
ULF23AE2J	*French for specific purpose-II*	H	-	H	-	H	H	-	M	H	-	H	H	-	-	-
UES23AE1T	*Environmental Studies*	H	-	H	-	H	H	-	M	H	-	H	H	-	-	-
UCD23V01T	*Universal Human Values*	H	M	M	L	-	M	-	M	H	L	H	L	-	-	-
UEN23V01L	*Communication Skills*	H	M	M	L	-	M	-	M	H	L	H	L	-	-	-
UCD23V02T	*Industry Oriented Employability Skills for Science*	H	M	M	L	-	M	-	M	H	L	H	L	-	-	-
UCD23V05L	*Career Readiness and Professional Skills*	H	M	M	L	-	M	-	M	H	L	H	L	-	-	-
UPY23P01L	*Internship - I*	-	H	-	H	-	-	-	-	-	H	H	-	-	-	-
UPY23P02L	*Internship - II*	-	H	-	H	-	-	-	-	-	H	H	-	-	-	-
UPY23P03L	*Mini Project*	-	H	-	H	-	-	-	-	-	H	H	-	-	-	-
UPY23P04L	*Internship - III*	-	H	-	H	-	-	-	-	-	H	H	-	-	-	-
UPY23P05L	*Project Phase-I*	-	H	-	H	-	-	-	-	-	H	H	-	-	-	-
UPY23P06L	*Project Phase-II*	-	H	-	H	-	-	-	-	-	H	H	-	-	-	-
UNS23201L	*NSS*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UNC23201L	*NCC*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UNO23201L	*NSO*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UYG23201L	*YOGA*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UMI23401L	*My India Project*	H	H	-	H	-	-	-	-	-	-	-	H	-	-	-

10. Structure of UG Courses in Physics

Distribution of different Courses in each semester with their credits for B.Sc. (Physics)

Semester	Compulsory Core Courses (CC) (Credit /Course)	Discipline Specific Elective (DSE) (Credit /Course)	Generic Elective (GEC) (Credit /Course)	Skill Enhancement Course (SEC) Life skills (Jeevan Kaushal) (Credit /Course)	Ability Enhancement (AE) (Credit /Course) (Credit /Course)	*Value Addition Course (V)* (Credit /Course)	Internship/ Apprenticeship / Project/ Community Outreach (IAPC) (Credit /Course)	Mandatory (M) (Credit /Course)	Total Credits
Sem I	CC-1 (4) CC-2 (4) CC-3 (4)	-	GE-1(3)	SEC-1(1)	AE-1(4)	V-1 (2)	-	-	**22**
Sem II	CC-4 (4) CC-5 (4) CC-6(4)	-	GE-2(3)	SEC-2(2)	AE-2(3)	V-2(2)	-	M1-(0)	**22**
Sem III	CC-7(4) CC-8 (4) CC-9 (4)	-	GE-3(4)	SEC-3(1)	AE-4(2)	V-3 (2)	IAPC-1(1)		**22**
Sem IV	CC-10(4) CC-11(4) CC-12(4)	-	GE-4(4)	SEC-4(2)	AE-4(2)	V-4(2)	-	M-2(0)	**22**
Sem V	CC-13(4) CC-14(4) CC-15(4)	DSE-1(4) DSE-2(4)	GE-5(4)	SEC-5(1)	-	-	IAPC-2(1)	-	**22**
Sem VI	CC-16(4) CC-17(4) CC-18(4)	DSE-3(4) DSE-4(4)	GE-6(4)	-	-	-	IAPC-3(2)	-	**22**
Sem VII	CC-19(4)	DSE-5(4) DSE-6(4)	GE-7(4) GE-8(4)	-	-	-	IAPC-4(2) IAPC-5(4)	-	**22**
Sem VIII	CC-20(4)	DSE-7(4) DSE-8(4) DSE-9(4) DSE-10(4)	GE-9(4)	-	-	-	IAPC-6(6)	-	**22**
Total Credits	**80**	**20**	**34**	**7**	**11**	**8**	**16**	**0**	**176**

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SYLLABI

SEMESTER I

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

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

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

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

Duration (hour)		12	12	12	12	12
S-1	SLO-1	தமிழ் இலக்கியத்தின் வளர்ச்சிப் போக்குகள்	நவீன கவிதை தோற்றம்	தமிழரின் வீரமரபு	சிற்றிலக்கியத் தோற்றம்	தமிழ் உரைநடை மரபில் உ.வே.சா.
	SLO-2	இலக்கிய உத்திகள்	நவீன கவிதை வரலாறு	போர் விழுமியங்கள்	சிற்றிலக்கிய வகைமை	ராஜ வைத்தியம்
S-2	SLO-1	தமிழ்க் கவிதை மரபு	நவீன கவிதை செல்நெறிகள்	பரணி அறிமுகம்	சிற்றிலக்கியங்கள்	வைத்தியர்களின் சிறப்பு
	SLO-2	காலந்தோறும் கவிதையின் கரு	செல்நெறிகளில் கோட்பாடுகள்	பரணி இலக்கியங்கள்	முதன்மைச் சிற்றிலக்கியங்கள் –	கழனியூரன் – அறிமுகம்
S-3	SLO-1	காலந்தோறும் கவிதையின் கட்டமைப்பு	கவிதை மொழி	கலிங்கத்துப்பரணி 477,490	பிள்ளைத்தமிழ் -உலா - தூது	சிறுதெய்வ வழிபாடு
	SLO-2	தற்கால இலக்கியம்	நவீன கவி ஆளுமைகள்	தலைவனின் வீரம்	புதுக்கவிதையில் சமூகம்	பொன் காத்த ஐயனார்
S-4	SLO-1	புதுக்கவிதை உருவாக்கம்	பெண் கவிஞர்கள்	தமிழ் இலக்கிய மரபில் தூது	புதுக்கவிதையும் இதழ்களும்	விருந்து – கள்ளர் செயல்கள்

	SLO-2	புதுக்கவிதை வளர்ச்சிநெறிகள்	கவிதையில் நாட்டுப்புற வடிவம்	தூது இலக்கியங்கள்	மணிக்கொடி இதழ்	பிழை நீக்கி எழுதுதல்
S-5	SLO-1	பாரதியார் – புதுக்கவிதையின் அடையாளம்	இளம்பிறை – அம்மா	தமிழ் விடு தூது (184 – 186)	எழுத்து இதழ்	எழுத்துப் பிழை
	SLO-2	பாரதியார் பன்முக ஆளுமைத்திறன்	பெண்களின் கல்வி நிலை	தமிழின் பெருமை	வானம்பாடி இதழ்	தொடர்பிழை
S-6	SLO-1	பாரத தேசம்	பெண் அடக்குமுறை	செய்யுள் மரபில் கலம்பகம்	சிறுகதை தோற்றம்	உயர்திணை, அஃறிணை
	SLO-2	பாரததேசத்தின் வளம்	ப. கல்பனா – கீறல் விழுந்த மாலைக் காலங்கள்	கலம்பக இலக்கியங்கள்	சிறுகதை வளர்ச்சி	பிறமொழிச் சொற்கள் வரலாறு
S-7	SLO-1	வெள்ளிப் பனிமலையின் மீதுலவுவோம்...	ஆண் பெண் சமத்துவம்	நந்திக் கலம்பகம்- வானுறு மதியை (110)	சிறுகதை – வரலாறு	பிறமொழிச் சொற்களை நீக்கி எழுதுதல்
	SLO-2	20 ஆம் நூற்றாண்டுக் கவிதை மரபில் பாரதிதாசன்	விளிம்புநிலை வாழ்வியல்	கையறுநிலை	சிறுகதை ஆசிரியர்கள்	ஷ, ஜ, ஸ, ஹ மாற்றொலிகள்
S-8	SLO-1	பாரதிதாசன் - அழகின் சிரிப்பு	திருநங்கை குணவதி - சமூகப்பார்வை	குறவஞ்சி அறிமுகம்	இதழ்களும் சிறுகதையும்	தமிழ் இலக்கண நுட்பங்கள்
	SLO-2	ஆல் - ஆயிரம் கிளைகள் கொண்ட அடிமரம்	திருநர்களும் சாதனைகளும்	குறவஞ்சி இலக்கியங்கள்	புதினம் தோற்றம்	இலக்கணமும் பயன்பாடும்
S-9	SLO-1	இயற்கையின் அழகியல்	புலம்பெயர் வாழ்வியல்	குற்றாலக் குறவஞ்சி – ஆடுமர வீனுமணி (3)	தொடக்கக்காலப் புதினங்கள்	தமிழில் சொல் வகைகள்
	SLO-2	வானம்பாடியில் மு.மேத்தா	ஸர்மிளா ஸெய்யித் – புராதன ஊர்	மலையும் வாழ்வும்	புதினம் வளர்ச்சி	சொல்லும் பயன்பாடும்
S-10	SLO-1	மு.மேத்தா - கவிதையின் தனித்தன்மைகள்	புலம் பெயர் வாழ்வின் வலியும் நம்பிக்கையும்	காப்பிய இலக்கணம்	புதினத்தின் வகைமை	பெயர்ச்சொற்கள்
	SLO-2	மனிதனைத்தேடி – கவிதை	காலந்தோறும் கவிதை வடிவில் மாற்றங்கள்	காப்பிய வகைமைகள்	புதின ஆசிரியர்கள்	பெயர்ச்சொற்கள் அறிதல்
S-11	SLO-1	மனிதநேயம்	ஹைக்கூ, லிமரைக்கூ, சென்ரியூ – தேர்ந்தெடுத்த கவிதைகள்	சிலப்பதிகாரம் – அறிமுகம்	தமிழ் இலக்கியத்தில் உரைநடைக்கூறுகள்	வினைச்சொற்கள்
	SLO-2	தமிழ்க் கவிதையில் சுற்றுச்சூழலியல்	ஹைக்கூ – மு.முருகேஷ்	கட்டுரைக்காதை	உரைநடையின் தோற்றம்	வினைச்சொற்கள் அறிதல்
S-12	SLO-1	பழனிபாரதியின் காடு	லிமரைக்கூ – ஈரோடு தமிழன்பன்	ஊழ்வினை	தமிழில் உரைநடை	தமிழில் பெயரடை, வினையடை
	SLO-2	இயற்கையும் சமூக சமத்துவ வாழ்வியலும்	சென்ரியூ – மாமதயானை	கோவலனின் முற்பிறப்பு வரலாறு	உரைநடை வளர்த்த அறிஞர்கள்	பெயரடை, வினையடை அறிதல்

Learning Resources	1. முல்லைக்காடு, தொகுப்பும் பதிப்பும் - தமிழ்த்துறை ஆசிரியர்கள், எஸ்.ஆர்.எம். அறிவியல் மற்றும் தொழில்நுட்பக் கல்விநிறுவனம், காட்டாங்குளத்தூர், 603203, 2023 2. வல்லிக்கண்ணன், புதுக்கவிதை தோற்றமும் வளர்ச்சியும், ஆழி பதிப்பகம், சென்னை, 2018 3. கா. சிவத்தம்பி, தமிழில் சிறுகதை தோற்றமும் வளர்ச்சியும், என்.சி.பி.எச்., சென்னை, 2013 4. தமிழ் இணையக் கல்விக்கழகம் - http://www.tamilvu.org/ 5. மதுரை தமிழ் இலக்கிய மின் தொகுப்புத் திட்டம் - https://www.projectmadurai.org/

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

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

Course Designers		
Experts from Industry	**Expert from Higher Technical Institutions**	**Internal Experts**
1. Dr. P.R.Subramanian, Director, Mozhi Trust, Thiruvanmiyur, Chennai – 600 041.	*1. Dr. V. Dhanalakshmi, Associate Professor, Subramania Bharathi School of Tamil Language & Literaturel, Pondicherry University, Pondicherry*	*1. Dr. B.Jaiganesh, Associate Professor & Head, Dept. of Tamil, FSH, SRMIST, KTR.*
		2. Dr. R. Ravi, Assistant Professor and Head, Dept. of Tamil, FSH, SRMIST, VDP.
		3. Mr. G. Ganesh, Assistant Professor, Dept. of Tamil, FSH, SRMIST, RMP.
		4. Dr. T.R.Hebzibah beulah Suganthi, Assistant Professor, Dept. of Tamil, FSH, SRMIST, KTR.
		5. Dr. S.Saraswathy, Assistant Professor, Dept. of Tamil, FSH, SRMIST, KTR.

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Course Code	ULH23G01J	Course Name	HINDI-I	Course Category	G	Generic Elective Course	L	T	P	O	C
							2	0	2	2	3

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

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

		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	To Communicate in Hindi without any inhibition			
CLR-2 :	To appreciate the Hindi Language in its various forms			
CLR-3 :	To analyze the different writing styles			
CLR-4 :	To display moral and social values in the field of social Responsibility and Integrity			
CLR-5 :	To be willing listeners and Translators-where need be			
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			
CLO-1 :	To Understand the Philosophy of life and living through Stories	2	75	80
CLO-2 :	To Examine Travelogue writing and Sketch	2	80	90
CLO-3 :	To Identify Irony and essay based writing	2	75	95
CLO-4 :	Evaluate the various social issues depicted in the prose	2	80	90
CLO-5 :	To Understand the basic and fundamental principal of Translation	2	85	90

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

Duration (hour)		12	12	12	12	12
S-1	SLO-1	KAHANI	REKHACHITRA & YATRAVITRANT	NIBANDH	NATAK	ANUVAD& PARIBHASHIK SHABDAVALI
	SLO-2	AVDHARNA	VDHARNA	IBANDH KI AVDHARNA	AVDHARNA	RTH
S-2	SLO-1	SWARUP	WAROOP	WARUP	NATAK KA SWARUP	ARIBHASHA
	SLO-2	PARIBHASHA	HUMIKA	ARIBHASHA	PARIBHASHA	WARUP
S-3	SLO-1	KAHANI KE TATVA	AHATVA	AHATVA	TATWA	RAKAR
	SLO-2	KAHANI KA MAHATVA	DDESHYA	DDESHYA	PRAKAR	AHATVA
S-4	SLO-1	PARIKSHA- PREMCHAND	ISHA- EKHACHITRA	UTAJ- NIBANDH AJARI PRASHAD DIVEDI	JDDESHYA	DDESHYA
	SLO-2	KAHANI KA PARICHAY	EKHIKA PARICHAY	EKHIKA PARICHAY	RANGMANCH KA PARICHAY	NUVAD KA PRAYOJAN
S-5	SLO-1	VISLESHAN	ATH KA ISHLESHAN	ATH KA MAHATVA	NATAK KA MAHATVA	NUVAD KA PRAYOG
	SLO-2	EMANDARI KA MAHATVA	URU SHISHYA KA AMBANDH	IPRIT PARISHTHITIYON ME EEVAN KI ASH	PRAYOJAN	HROT BHASHA KA GYAN
S-6	SLO-1	HONHARI KA PARICHAY	GURU KE PRATI SMARPAN BHAVANA	MANAV KI AKANKSHAYEN	ANDHER NAGRI-(NATAK) BHARTENDU HARISHCHAND	LAKSHYA BHASHA KA GYAN
	SLO-2	UDDESHYA	PATH KA MAHATVA	SHANGHARSHIL JEEVAN	LEKHAK PARICHAY	ANUVAD KA DAYITVA
S-7	SLO-1	MALBE KA MALIK- MOHAN RAKESH	HELE PAR HIMALAY (YATRAVITRANT)	SANGHARSH KA PARINAM	NATAK KA VISLESHAN	ANUVAD KA ABHYASH
	SLO-2	LEKHAK PARICHAY	LEKHAK PARICHAY	BHOLARAM KA JEEV-(VYANGYA) HARISHANKAR PARSHAI	NATAK ABHINAY	ANGREJI SE HINDI
S-8	SLO-1	BATWARE KA YATHARTH VARNAN	YATRAVITRANT KA MAHATVA	VYANGYA KI AVADHARNA	LALCH KA DUSHPARINAM	HINDI SE ANGREJI
	SLO-2	TATKALIN PARISHTHITI KA VARNAN	YATRA KA YATHARTH CHITRAN	MAHATVA	SHISHYA KI AGYANTA	ANUVAD PRIYOJNA KARYA
S-9	SLO-1	APNI MITTI SE LAGAV	PATH KA VISLESHAN	LEKHAK PARICHAY	GURU SHISHYA SAMBANDH	PUNRIKSHAN
	SLO-2	RAJNITIK VIDWESH KA PARINAM	HIMALAY KA VARNANA	PATH KA VIHLESHAN	HASHYA VYANGY SE AVAGAT KARANA	VIVIDH PRAYOG
S-10	SLO-1	PROPKAR KI BHAVANA	HIMALAY KA LOK JEEVAN	MADHYAVARGI PARIVAR KI STHITI	DURDRISHTIHIN	PARIBHASHIK SHABDAVALI

	SLO-2	*KAHANI PATH*	*LOK SAMASYA*	*SARKARI TANTRA KA KHOKHLA RUP*	*MAHATTAKANKSHI KA DUSHPARINAM*	*ATI MAHTVAPURN SHABD*
S-11	***SLO-1***	*KAHANI KA VISHLESHAN*	*UDDESHYA*	*PAURANIK KATHA KA CHITRAN*	*GURU KI AVAGYA KA DUSHPARINAM*	*TAKANIKI SHABDAVALI KA MHATVA*
	SLO-2	*PRASHO KI CHARCHA*	*PRASHNA ABHYASH*	*SANVEDANSHIL BHAVANA*	*TATKALIN SAMAJIK VYAVASTHA KI CHARCHA*	*HINDI SE ANGREZI SHABD*
S-12	***SLO-1***	*PRASHN ABHYASH*	*PATH PRICHARCHA*	*PARICHARCHA*	*PARICHARCHA*	*ANGREZI SE HINDI SHABD*
	SLO-2	*KAHANI KA UDDESHYA*	*MAHATVAPURN BIBDUON KI CHARCHA*	*PRASHANA ABHYASH*	*PRASHNABHYASH*	*SHABDAVALI KI AVSHYAKTA*

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

Learning Assessment

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

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

Course Designers

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

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

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

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

		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Extend and expand their savoir-faire through the acquisition of current scenario*			
CLR-2 :	Enable the students to overcome the fear of speaking a foreign language and take position as a foreigner speaking French			
CLR-3 :	Make them learn the basic rules of French Grammar.			
CLR-4 :	Develop strategies of comprehension of texts of different origin			
CLR-5 :	Strengthen the language of the students both in oral and written			

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

Duration (hour)		12	12	12	12	12
S-1	SLO-1	**Contacts**	Les verbes du premier groupe	**Qu'est-ce qu'ils font ?**	**Portraits**	Les verbes du deuxième groupe –
	SLO-2	**Emma la championne**	**Les exemples**	**Les exemples**	**Un casting**	Les exemples
S-2	SLO-1	Les nombres à partir de 31	La liaison	**Où est mon sac**	Les exemples	Les pronoms personnels toniques
	SLO-2	Les activités	Les activités	Les exemples	Les activités	Les exemples
S-3	SLO-1	Les pays	Entrer en contact	Quelques objets	**Le Petit Spirou**	Les verbes faire et lire
	SLO-2	les nationalités	Les activités	Les exemples	Les activités	Les exemples
S-4	SLO-1	Les jours de la semaine	Présenter et se présenter	Les professions	L'aspect physique	*Les Sons*
	SLO-2	Les jours	Les activités	La fiche d'identité	Les activités	Les exemples
S-5	SLO-1	Les mois de l'année	Demander et dire la date	La formation du féminin (2)	Le caractère	*Décrire l'aspect physique*
	SLO-2	Les activités	Les activités	La phrase interrogative partielle –	Les exemples	*Décrire le caractère*
S-6	SLO-1	Les animaux domestiques	une rencontre.	*Qu'est-ce que c'est ?*	les états d'âme	*Demander et dire l'heure*
	SLO-2	Les activités	Les activités	*Qui est-ce ?*	Les activités	Les exemples
S-7	SLO-1	La famille (1)	Contacts	*C'est / Il est (1)*	Les prépositions de lieu (1)	*Elle est comment ?*
	SLO-2	Les activités	Les activités	**Les exemples**	Les exemples	Les exemples
S-8	SLO-1	La formation du féminin (1)	Emma la Championne	La phrase négative (1)	La famille (2)	*Portraits*
	SLO-2	Les activités	Les activités	Les exemples	Les activités	Les exemples
S-9	SLO-1	Les adjectifs possessifs	Mots et expressions	Les verbes aller et venir	La formation du féminin	*Mots et Expressions*
	SLO-2	Les exemples	Les activités	L'élision	Les activités	Les activités
S-10	SLO-1	La phrase interrogative	Grammaire -	Les formules de politesse	La formation du pluriel (2)	*Grammaire.*
	SLO-2	Les exemples	**Les** exemples	Demander des informations personnelles	Les activités	Les exemples
S-11	SLO-1	Les activités	Communication	C'est qui ?	*Il y a*	Les activités
	SLO-2	Les nombres	Les activités	Qu'est-ce qu'ils font ?	Les activités	*Communication*

S-12	**SLO-1**	intonation et *est-ce que*	*Les verbes du ER –groupe*	Mots et Expressions	Les articles contractés	Les activités
	SLO-2	Les exemples	Les exemples	Grammaire – Communication	Les exemples	Les exemples

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

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

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

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

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

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

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

		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking	Expected	Expected	Fundamental	Application of	Link with Related	Procedural	Skills in	Ability to Utilize	Skills in Modeling	Analyze, Interpret	Investigative Skills	Problem Solving	Communication	Analytical Skills	PSO -1	PSO -2	PSO-3
CLR-1 :	Develop an understanding and sensibility of human consciousness through gender inclusive curriculum																		
CLR-2 :	Enhance the abilities of deeper understanding to stay with integrity with the fellow human beings																		
CLR-3 :	Develop the overall language competency of the learner																		
CLR-4 :	Develop proficient language skills																		
CLR-5 :	Learn to express the thoughts clearly, develop logical arguments and enhance the overall communication skills.																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	Analyze different literary texts to identify the representation of issues related to gender, and class	2	75	60	H	M	M	L	-	M	-	M	H	L	H	L	-	-	-
CLO-2 :	Apply critical thinking skills to analyze and respond to academic texts.	2	80	70	M	H	L	-	-	-	-	M	M	H	H	M	-	-	-
CLO-3 :	Critically evaluate and discuss contemporary issues through online articles.	2	70	65	M	M	M	-	L	L	-	H	M	H	H	L	-	-	-
CLO-4 :	Refine their general writing skills	2	70	70	H	M	L	-	M	H	-	-	-	-	H	L	-	-	-
CLO-5 :	Improve their language application skills	2	80	70	H	H	-	M	-	M	-	L	L	M	H	M	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Introduction to the poetry and the poet- Sukirtharani	Introduction to Short stories. Introducing the short story writer Katherine Mansfield.	Introduction to Creative Writing. Explaining the elements of creative writing.	Building the discourse- The significance of conversation and the key elements of discourse are the points of discussion in this class hour.	Reflecting the learning. -Review writing
	SLO- 2	Reading and recitation of the poem -Debt	Reading the story- The Doll's House	Stand-up comedy show - translate the audio content in English. (any regional language)	Art of conversation in digital and verbal discourse- Lee Mockobe's A Powerful Poem of what it means to be a Transgender. TEDX TALK- POEM RECITATION	Choosing the subject for reviewing.
S-2	SLO-1	Analysis and Critical interpretation of the poem.	Explaining the story through depiction of characters and representation of injustices.	Students- groups -Students belonging to States other than Tamilnadu	Reflecting on the style and the tone of the poem.	Planning to choose.
	SLO- 2	Introduction to the poet Kalki Subramaniyam.	Analysis and critical interpretation of the short story Doll's House.	Practice the writing activity - creative ways of engaging in translation.	Practicing conversation	Understand the review process how effectively a review of any work can be done.
S-3 – S-4	SLO-1	Reading and recitation of the poem Phallus I cut.	Introduction to the writer Haruki Murakami.	Correction of errors- attempting to translate.	Introducing Content writing in Social Media- the importance of content writing.	Introducing the students to the review of the various works.

	SLO- 2	*Analysis and Critical interpretation of the poem.*	*Reading the Confessions of a Shinawaga monkey.*	*Identifying equivalent terms to certain regional words - learn the art of translation.*	*.BLOG WRITING - Subtleties Of Workplace Inclusion: Mental Health And Queer Community- Salik Ansari.* .	*Reviewing -recorded -posted in the social media pages of SRMIST*
S-5	**SLO-1**	*Introduction to the poet Imtiaz Dharker*	*Discussion and analysis of the Confessions of a Shinawaga monkey.*	*Introducing famous art works and the contexts of creation. Salvador Dali- The Face of War Pablo Picasso- Guernica Edward Munch- The Scream Pieter Bruegel- The Tower of Babel*	*writer's conversation with the readers - the blog in other blog articles..*	*Thoughtful conversation with your team member post the same in the official social media page of SRMIST.*
	SLO- 2	*Reading and reciting the poem Purdah 1*	*Introduction to Crystal Wilkinson*	*creative and/ or thoughtful writing - contemporary themes of modern day relevance*	*Practice blog writing*	*Choosing the team based on the abilities that are comfortable to match the peer members*
S-6	**SLO-1**	*Analysis and Critical interpretation of the poem- Purdah 1*	*Reading Endangered Species: Case 47401.*	*Students -writing abilities- building stories- a visual treat of variety of pictures.*	*Apprehending Life by reading the texts of influence- Chimamanda Ngozi Adiche's Notes on Grief- A BRIEF NOTE, We should all be Feminists- An Essay.*	*Choosing the topics for a thoughtful conversation*
	SLO- 2	*Reading and reciting the poem Purdah 2*	*Discussion and analysis of Endangered Species: Case 47401.*	*Elements of writing*	*Discussion- essay by the author - subjective depiction of life. Understand -subjective opinions - perspectives -*	*Planning and preparation for the script of conversation with a team member*
S-7 – S-8	**SLO-1**	*Analysis and Critical interpretation of the poem- Purdah 2*	*Introduction to C.S Lakshmi also known as Ambai.*	*Incorporate the elements of story in story writing.*	*Class discussion*	*Drafting , editing and revising the script of conversation and enacting the conversation with the team members*
	SLO- 2	*Introduction to the poet Arundathi Subramanian*	*Reading the short story- In a Forest, A Deer.*	*Practice -write stories -pictures given or shown .*	*Practising the task multiple times with all the students in the classroom.*	*Enactment -proper rehearsal -final performance -conversation- whole performance should be recorded.*
S-9	**SLO-1**	*Reading and reciting the poem- Home*	*Discussion and Analysis of In a Forest, A Deer.*	*A writing task to write a script is introduced in the classroom.*	*Interposing opinions in famous interviews-*	*The recording should be posted in the official media page and social handles of SRMIST.*
	SLO- 2	*Analysis and Critical interpretation of the poem- Home*	*Retrospecting the writing styles of the authors- Katherine Mansfield, Haruki Murakami, Crystal Wilkinson and Ambai.*	*creative scripts inspiring from the dialogues of their favourite films by changing the scenario to their own wish according to their own whims and fancies.*	*Interposing opinions in famous interviews- FII Interviews: Tasveer Co-Founder And Filmmaker Rita Meher On The Seattle Legislation, Minority Rights And The Fight Against Oppression- INTERVIEW*	*work for this social post - reflect on their experience of learning communicative English course and the testimonial has to be recorded and posted in the social media pages of SRMIST..*
S-10	**SLO-1**	*Recollection of study of the writing styles and intentions of the poets prescribed in the syllabus.*	*Revision- The Doll's House*	*Creative writing -writing news reports. recreated with new characters, places, scenes, incidents.*	*Students -enact as interviewer and interviewee and practice building the discourse.*	*Involving the students for the project work. Introducing what is project work and inculcating the interest -Giving instructions to do the project works -*
	SLO- 2	*Revision of the poems Debt and Phallus I cut*	*Revision- Confessions of a*	*Watch debate shows - summarising the arguments*	*Certain role plays like celebrity personalities, political personalities -conduct the*	*Discussion of ideas and generation of creative ideas*

			Shinawaga Monkey	*Enhance -descriptive writing skill.*	*interview and be the interviewer and interviewee.*	
S 11 - S 12	***SLO-1***	*Revision of the poems Purdah 1 and 2*	*Revison- Endangered Species: Case 47401*	*Practice the* improvement *of writing skill.*	*The art of conversation and the ability to build a discourse*	*1. Assignment on any piece of creative writing (OR)* *2. Presentation- Mastering the art of Public Speaking. (OR)* *3. Project on compiling the real life influential events on gender inclusive issues and a presentation of the same. Interview Scripting /Blog writing.*
	SLO- 2	*Revision of the poem Hiome.*	*Revision- In a Forest, A Deer.*	*Repetitive practice and continuous assessment -writing skiills-master the writing skill.*	*The evaluation and assesment of the conversation -constructive feedbacks to the students.*	*Students can opt any of the project from the given choice.*

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

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

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

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Krishna Raj *Sutherland* *Krishna.Raj1@sutherlandglobal.com*	*Dr. J Mangayarkarasi* *Associate Professor and Head, Dept. of English Ethiraj College for Women* *Chennai* *jmbwilson97@gmail.com*	*Dr. Pushpanjali Sampathkumar, Assistant Professor, Department of English, FSH, SRMIST*
Ann Mariya Thomson *RA2232105010015* *II M.A English Literature* *CSH, SRM IST* *az1160@srmist.edu.in*	*Dr. K S Antonysamy* *Associate Professor and Head, Dept. of English Loyola College* *Chennai* *antonysamyks@loyolacollege.edu*	*Dr. Dr. Shanthichitra, Associate Professor, & Head, Department of English, FSH,SRMIST* *Dr Anchal Sharma, Prof & Hod EFL SRMIST NCR Campus* *Dr T Sridevi, Assistant Professor English, FSH Ramapuram SRM* *Dr Shanmuga Priya, Assistant Professor SRMIST Trichirapalli Campus*

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Course Code	UPY23101J	Course Name	Mathematical Physics-I	Course Category	C	*Professional Core Course*	L	T	P	O	C
							3	0	2	2	4

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

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1:	*teach the mathematical skills for the application in the physics*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2:	*apply the divergence and curl theorems for several physical problems*			
CLR-3:	*express the differential equations to the theoretical physics*			
CLR-4:	*learn about the series expansion*			
CLR-5:	*learn to represent the periodic functions*			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1:	*understand the linear algebra through matrices*	4	80	75
CLO-2:	*solve the vector calculus and its application in physical fields*	4	80	70
CLO-3:	*use of the complex variable in the response theory and potential theory*	4	75	70
CLO-4:	*use the differential equations to express physical processes and set the boundary conditions*	4	80	75
CLO-5:	*able to resolve the unsolved and complex theoretical works in physics*	4	80	70

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

Duration (hour)		15	15	15	15	15
S-1	SLO-1	Vector Analysis	Matrix Analysis	Differential equations	Functions of Complex Variables	Fourier Series
	SLO-2	Introduction	Vector Space	First order homogeneous and non-homogeneous equations with variable coefficients	Algebraic operations	Periodic function
S-2	SLO-1	Cartesian Systems of Base vectors	linear dependence	First order homogeneous and non-homogeneous equations with variable coefficients	Algebraic operations	Periodic function
	SLO-2	an orthonormal basis	Hilbert space	Superposition principle	Euler's formula	Odd and even functions
S-3	SLO-1	Vector algebra with coordinates	linear operators	Superposition principle	Euler's formula	Odd and even functions
	SLO-2	Differentiation of vector functions	Definition of matrix	Second order homogeneous and non-homogeneous equations with constant coefficients	Single and multivalued functions	Square and Triangular wave
S-4 to 5	SLO-1	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2					
S-6	SLO-1	Gradient	Basic Matrix operations	Second order homogeneous and non-homogeneous equations with constant coefficients	Single and multivalued functions	Square and Triangular wave
	SLO-2	divergence & curl	Basic Matrix operations	Partial differential equations of theoretical physics	Single and multivalued functions	Saw-Tooth wave
S-7	SLO-1	Integration of vector functions	Basic Matrix operations	Partial differential equations of theoretical physics	Analytic functions	Saw-Tooth wave
	SLO-2	Integration of vector functions	Basic Matrix operations	Partial differential equations of theoretical physics	Analytic functions	Euler formula for Fourier series

S-8	**SLO-1**	Gauss Divergence theorem	Matrix Multiplication	Method of direct integration	Analytic functions	Euler formula for Fourier series
	SLO-2	Gauss Divergence theorem	Complex conjugation and transposition	Method of direct integration	Harmonic functions	Fourier Cosine and Sine series
S-9 to 10	**SLO-1**	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2					
S-11	**SLO-1**	Curl (Stokes) theorem	Classification of matrices	Method of direct integration	Harmonic functions	Fourier Cosine and Sine series
	SLO-2	Curl (Stokes) theorem	Determinant and its properties Definitions Symmetric and skew-symmetric matrix	Method of direct integration	contour Integrals	change of intervals
S-12	**SLO-1**	Green's theorem	Definitions of Hermitian and skew-Hermitian matrix Orthogonal matrix Unitary matrix	Method of separation of variables.	Cauchy Riemann Conditions	complex form of Fourier series
	SLO-2	Green's theorem continued	Trace of a matrix and its properties and inverse matrix	Method of separation of variables.	Cauchy's Integral Theorem	summation of Fourier series
S-13	**SLO-1**	Green's theorem: example of applications	Eigenvalues and eigenvectors Characteristic equation	Method of separation of variables.	Cauchy Integral Formula. Differentiation inside the sign of Integration	Gibb's Phenomenon
	SLO-2	example of applications	Statement: Cayley –Hamilton theorem	Method of separation of variables.	Taylor series expansion and Laurent series expansions (without derivation)	Properties of Fourier Series.
S-14 to 15	**SLO-1**	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2					

Learning Resources

1. G. Arfken and H.J. Weber, *Mathematical Methods for Physicists*, 6th Ed., Academic Press, SanDiego, 2005.
2. P.K. Chattopadhyay, *Mathematical Physics*, Wiley Eastern, New Delhi, 2005.
3. C. Harper, *Introduction to Mathematical Physics*, Prentice Hall of India, New Delhi, 2004.
4. M.R. Spiegel, *Schaum's Outline of Advanced Mathematics for Engineers and Scientists*, 1st Ed., McGraw Hill, 2009.
5. L.A. Pipes, *Applied Mathematics for Engineers and Physicists*, McGraw-Hill, 1958.
6. M.L. Boas, *Mathematical Methods in the Physical Sciences*, 3rd Ed., John Wiley, 2005.
7. M.R. Spiegel, Seymour Lipschutz, John J. Schiller, and Dennis Spellman, *Schaum's outline of Complex Variables*, 2nd Ed., McGraw Hill, 2009.
8. B.D. Gupta, *Mathematical Physics*, 4th Ed., Vikas Publishing House, 2009.
9. S. Hassani, *Mathematical Physics: A Modern Introduction to Its Foundations*, 2nd Ed., Springer, 2013.
10. P.K. Chattopadhyay, *Mathematical Physics*, 1st Ed., New Age International, 2009.

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*30 %*	*30 %*	*30 %*	*30 %*	*30 %*	*30 %*	*30 %*	*30 %*	*30%*	-
Level 2	Understand										
Level 3	Apply	*40 %*	*40 %*	*40 %*	*40 %*	*40 %*	*40 %*	*40 %*	*40 %*	*40%*	-
Level 4	Analyze										
Level 5	Evaluate	*30 %*	*30 %*	*30 %*	*30 %*	*30 %*	*30 %*	*30 %*	*30 %*	*30%*	-
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
1. Mr. R. Seshadri , Titan company ltd, seshadri@titan.co.in	*1 Ranjit Kumar Nanda, IIT Madras, nandab@iitm.ac.in*	*Dr. Sanjay Kumar Mehta, SRMIST*
2. Dr. D. K. Aswal , NPL, dkaswal@nplindia.org	*2. Prof. C. Vijayan, IIT Madras, cvijayam@iitm.ac.in*	*Dr Alok Kumar, SRMIST*

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Course Code	UPY23102J	Course Name	Classical Mechanics-I	Course Category	C	Professional Core Course	L	T	P	O	C
							3	0	2	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:
CLR-1:	*emphasize the basic mathematical formulation of mechanics problems*
CLR-2:	*apply the fundamental concepts of mechanics to solve mechanics problems*
CLR-3:	*apply concepts in mechanics to rotational motion*
CLR-4:	*develop the theory of central forces*
CLR-5:	*understant the postulates of special theory of relativity and its implications*

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning 1 Level of Thinking (Bloom)	Learning 2 Expected Proficiency (%)	Learning 3 Expected Attainment (%)	PLO 1 Fundamental Knowledge	PLO 2 Application of Concepts	PLO 3 Link with Related	PLO 4 Procedural Knowledge	PLO 5 Skills in Specialization	PLO 6 Ability to Utilize	PLO 7 Skills in Modeling	PLO 8 Analyze, Interpret Data	PLO 9 Investigative Skills	PLO 10 Problem Solving Skills	PLO 11 Communication Skills	PLO 12 Analytical Skills	PLO 13 PSO - 1	PLO 14 PSO - 2	PLO 15 PSO - 3
CLO-1:	*learn how to describe motion in one, two and three dimensions*	4	80	75	H	-	-	-	-	-	-	-	-	M	-	H	-	-	-
CLO-2:	*understand conservative force fields and applications*	4	80	70	H	-	-	-	-	-	-	-	-	M	-	H	-	-	-
CLO-3:	*understand rotational motion and variables associated with it*	4	75	70	H	-	-	-	-	-	-	-	-	M	-	H	-	-	-
CLO-4:	*learn the theory of central forces and its applications*	4	80	75	H	-	-	-	-	-	-	-	-	M	-	H	-	-	-
CLO-5:	*learn special theory of relativity and its consequences*	4	80	70	H	-	-	-	-	-	-	-	-	M	-	H	-	-	-

Duration (hour)		15	15	15	15	15
S-1	SLO-1	Motion in one dimension	Newton's laws of motion - 1	Rotational variables	Inertial vs non-inertial frames	Introduction to relativity
	SLO-2	Displacement, average velocity, instantaneous velocity	Newton's laws of motion - 2	Angular position, angular displacement,	Examples of non-inertial frames	Galilean transformation
S-2	SLO-1	Average acceleration, instantaneous acceleration	Some particular forces	Angular velocity, angular acceleration	Concept of pseudo force	Velocity and acceleration under Galilean transformations
	SLO-2	Equations for motion with constant acceleration - 1	Applications of Newton's laws	Rotations with constant angular acceleration	Rotating frame of reference	Ether hypothesis
S-3	SLO-1	Equations for motion with constant acceleration - 2	Kinetic energy and expression for work	Relation between linear and angular variables	Expression for Coriolis force	Michelson-Morley experiment
	SLO-2	Free-fall acceleration	Work-kinetic energy theorem	Kinetic energy of rotation	Expression for centrifugal force	Explanation of the negative result
S-4 to S-5	SLO-1	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2					
S-6	SLO-1	Motion in two and three dimensions	Concept of potential	Moment of inertia	Effect of centrifugal force due to earth's rotation on g	Postulates of special theory of relativity
	SLO-2	Average velocity, instantaneous velocity	Conservative force and its path independence of work done	Parallel-axis theorem	Coriolis force due to earth's rotation	Time dilation
S-7	SLO-1	Average acceleration, instantaneous acceleration	Simple harmonic oscillator - Hooke's law	Proof of parallel-axis thorem	Kepler's laws of planetary motion - 1	Relativity of simultaneity
	SLO-2	Projectile motion	Equation of motion for a SHO	Applications of parallel-axis thorem	Kepler's laws of planetary motion - 2	Twin paradox
S-8	SLO-1	Equation of the trajectory	Position, velocity, acceleration of a SHO	Torque	Motion under central force	Length contraction
	SLO-2	Equations for range, time-of-flight, height	Conservation of mechanical energy of a SHO	Newton's second law for rotation	Characteristics of motion under central force	Lorentz transformation equations
S-9 S-to 10	SLO-1	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2					
S-11	SLO-1	Plane polar coordinates	Linear momentum	Torque and Angular Momentum	Derivation of equation of orbit	Einstein's velocity addition formula
	SLO-2	Unit vectors in plane polar coordinates	Conservation of linear momentum	Newton's second law in angular form	Equation of a conic section	Relativistic momentum
S-12	SLO-1	Velocity in plane polar coordinates	Centre of mass of a system of particles	Angular momentum of a rigid body rotation about a fixed axis	Motion under inverse-square law	Relativity of mass

	SLO-2	Acceleration in plane polar coordinates	Centre of mass of solid objects	Conservation of Angular Momentum	Derivation of Kepler's laws from theory of central force - 1	Mass and energy
S-13	**SLO-1**	Uniform circular motion	Newton's second law for a system of particles	Precession of a spinning top	Derivation of Kepler's laws from theory of central force - 2	Energy and momentum
	SLO-2	Centripetal acceleration	Linear momentum of a system of particles	Expression for precession frequency	Derivation of Newton's law of gravitation from Kepler's laws	Kinetic energy at low speeds
S-14 to S-15	**SLO-1**	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2					

Learning Resources	1. Halliday, Resnick and Walker (2015), "Fundamentals of Physics" – 10th ed. Wiley, New York 2. Classical Mechanics, John R Taylor, University Science Books, 2005. 3. Mechanics Berkeley Physics course, v.1 Charles Kittel (Tata McGraw Hill, 2007)	4. An Introduction to Mechanics David Kleppner, Robert Kolenkow McGraw Hill Education India, 2007 5. Concepts of Modern Physics, Arthur Beiser, 7th ed, McGraw-Hill Higher Education

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	30 %	*30 %*	30 %	*30 %*	30 %	*30 %*	30 %	*30 %*	30 %	-
Level 2	Understand										
Level 3	Apply	40 %	*40 %*	40 %	*40 %*	40 %	*40 %*	40 %	*40 %*	40 %	-
Level 4	Analyze										
Level 5	Evaluate	30 %	*30 %*	30 %	*30 %*	30 %	*30 %*	30 %	*30 %*	30 %	-
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	Dr. Sivakumar, SRMIST
Dr. M Sathish, CSIR-CECRI, msathish@cecri.re.in	Prof. C Venkateshwaran, University of Madras, venkateshwaran@unom.ac.in	Dr. Debabrata Sarkar, SRMIST

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Course Code	UPY23103J	Course Name	Properties of Matter and Acoustics	Course Category	C	Professional Core Course	L	T	P	O	C
							3	0	3	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	*Disseminate the knowledge of different kinds of moduli and the concept of bending in beams*			
CLR-2 :	*Understand the basics of viscosity of fluids via experimental methods*			
CLR-3 :	*Learn and comprehend the concepts of surface tension*			
CLR-4 :	*Understand the wave phenomena: in general, and sound wave in particular*			
CLR-5 :	*Acquire knowledge on the production of ultrasonic waves and its applications*			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking	Expected Proficiency	Expected Attainment	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Fundamental	Application of Concepts	Link with Related	Procedural Knowledge	Skills in Specialization	Ability to Utilize	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	*Understand the concept of bending and analyze the Young's modulus via experimental methods*	3	80	85	H	H	-	-	-	-	-	H	-	-	-	-	-	-	-
CLO-2 :	*Acquire knowledge on viscosity of fluids and its determination*	1	75	80	H	H	-	-	-	-	-	H	-	-	-	-	-	-	-
CLO-3 :	*Explore how temperature affects the surface tension in liquids*	3	85	80	H	H	-	-	-	-	-	H	-	-	-	-	-	-	-
CLO-4 :	*Know about the concept of wave phenomena and implications*	3	80	75	H	H	-	-	-	-	-	H	-	-	-	-	-	-	-
CLO-5 :	*Understand the generation of ultrasonic waves*	1	75	85	H	H	-	-	-	-	-	H	-	-	-	-	-	-	-

Duration (hour)		18	18	18	18	18
S-1	SLO-1	*Elasticity – Three types of elastic moduli*	*Streamline and turbulent flow*	*Surface Tension*	*Sound Waves*	*Ultrasonics*
	SLO-2	*Relation among elastic moduli*	*Rate of flow of liquid in a capillary tube*	*Molecular forces*	*Intensity and loudness of sound*	*Properties of Ultrasonics*
S-2	SLO-1	*Poisson's ratio*	*Energy of the Liquid - Kinetic energy and Potential Energy*	*Explanation of surface tension on kinetic theory*	*Intensity levels*	*Concept of Magnetostriction Effect*
	SLO-2	*Bending of beams-Expression for bending moment*	*Pressure energy of the liquid*	*Surface energy and Surface tension*	*Types of Vibration*	*Production of Ultrasonics using Magnetostriction Oscillator*
S-3	SLO-1	*Depression of the loaded end of a Cantilever*	*Viscosity*	*Pressure difference across a liquid surface*	*Concept of Free Vibrations*	*Concept of Piezo Electric Effect*
	SLO-2	*Numerical on determination of Depression*	*Coefficient of Viscosity*	*Numerical on determination of Surface Tension*	*Concept of Damped Vibrations*	*Production of Ultrasonics using Piezoelectric oscillator*
S-4 to S-6	SLO-1	*Basics of Experimentation*	*Determination of Young's modulus of the material of the beam – NonUniform Bending (Scale and Telescope)*	*Repeat/Revision of experiment*	*Determination of surface tension of the liquid-Capillary raise method*	*Generation of Lissajous figure using Signal Generator.*
	SLO-2					
S-7	SLO-1	*Uniform Bending method: Theory*	*Poiseuille's Equation for flow of liquid through a tube and its correction*	*Excess of pressure inside curved surfac*	*Concept of forced Vibrations*	*Applications of Ultrasonics – NDT, SONAR*
	SLO-2	*Uniform Bending method: Experiment pin and microscope method*	*Capillary flow method - Experimental Determination of Coefficient of Viscosity for a liquid*	*Application to spherical and cylindrical drops and bubbles*	*Theory of Forced Vibrations*	*Applications of ultrasonic in medicine*
S-8	SLO-1	*Non-Uniform Bending method: Theory*	*Viscosity of highly viscous liquid*	*Experimental study of variation of Surface tension with temperature*	*Resonance*	*Acoustics of buildings*
	SLO-2	*Non-Uniform Bending method: Experiment pin and microscope method*	*Reynolds number and Terminal velocity*	*Drop weight method of determining surface tension*	*Sharpness of Resonance*	*Sound Absorption*
S-9	SLO-1	*Koenig's method: theory*	*Stokes method for the Coefficient of a highly viscous liquid*	*Angle of contact*	*Fourier's theorem*	*Sound Absorption coefficient*
	SLO-2	*Koenig's method for nonuniform bending*	*Comparison of Viscosities - Ostwald Viscometer*	*Determination of Angle of Contact*	*Evaluation of Fourier Coefficient*	*Numerical on determination of absorption coefficient*

S-10 to S-12	**SLO-1** **SLO-2**	*Determination of Young's modulus of the material of the beam - Uniform Bending (Pin and Microscope)*	*Determination of Young's modulus of the material of the beam – Uniform Bending (Scale and Telescope)*	*Determination of elastic constants of a wire by Searle's method*	*Determination of coefficient of viscosity of liquid-Poiseuille's flow method*	*Determination of acceleration due to gravity-Compound bar pendulum*
S-13	**SLO-1**	*Torsion of a body*	*Variations of viscosity with temperature and pressure*	*Angle of contact of mercury*	*Application of Fourier's theorem – Saw Tooth wave*	*Reverberation*
	SLO-2	*Expression for couple per unit twist*	*Problems/Demos/ Simulations/Seminars on determination of Coefficient of Viscosity*	*Quincke's method*	*Application of Fourier's theorem – Square wave*	*Reverberation time*
S-14	**SLO-1**	*Torsion pendulum*	*Determination of Viscosity of Gases*	*Surface tension and Vapor pressure osmosis*	*Laws of transverse vibration of strings*	*Optimum Reverberation time*
	SLO-2	*Determination of rigidity modulus by torsion pendulum with mass*	*Mayer's formula for the rate of flow of a gas through a capillary tube*	*Laws of osmosis pressure*	*Frequency Determination and Sonometer*	*Derivation of Sabine's formula*
S-15	**SLO-1**	*Static torsion method with scale and telescope*	*Rankine's method for the determination of viscosity of a gas*	*Experimental determination of osmotic pressure*	*A.C. frequency using Sonometer*	*Factors affecting Acoustics of buildings*
	SLO-2	*Numerical on determination of Rigidity Modulus*	*Numerical on determination of viscosity of gas*	*Numerical on determination of Osmotic Pressure*	*Determination of frequency using Melde's apparatus*	*Numerical on determination of reverberation time*
S-16 to S-18	**SLO-1**	*Determination of Young's modulus of the material of the beam - Non uniform bending (Pin and Microscope)*	*Determination of rigidity modulus using Torsional Pendulum – Without masses*	*Determination of rigidity modulus using static torsion method*	*Determination of AC frequency main using Sonometer.*	*Repeat/Revision of experiment*

Learning Resources	1. Properties of Matter, Revised Edition, DS Mathur (S. Chand and Company2010). 2. Understanding the Properties of Matter, Michael de Podesta (CRC Press; 2 edition, 2002) 3. Properties of Matter and Acoustics, Revised Edition, Murugesan R., (S. Chand and Company, 2012).	4. University Physics, Ronald Lane Reese, (Thomson Brooks/Cole, 2 edition , 2005) 5. Textbook of Sound, Khanna and Bedi, (Atma Ram & Sons, 1985). 6. The Feynman Lectures on Physics, Vols. I, II, and III, R. P. Feynman, R B Leighton and M Sands, The New Millennium Edition 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	40 %	40 %	30 %	40 %	30 %	40 %	30 %	40 %	30 %	40 %
Level 2	Understand										
Level 3	Apply	40 %	40 %	40 %	40 %	40 %	40 %	40 %	40 %	40 %	40 %
Level 4	Analyze										
Level 5	Evaluate	20 %	20 %	30 %	20 %	30 %	20 %	30 %	20 %	30 %	20 %
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
-	Prof. VS Subramanian, IIT Madras, manianvs@iitm.ac.in	Dr. C. Preferencial Kala, SRMIST
	Prof. C Venkateshwaran, University of Madras, venkateshwaran@unom.ac.in	Dr. RM Hariharan, SRMIST

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

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Demonstrate various principles involved in solving mathematical concepts	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	Critically evaluate basic mathematical concepts related to profit, loss, interest calculations, average and interpret data			
CLR-3 :	Enable students to understand reasoning skills			
CLR-4 :	Use the basic mechanics of Grammar			
CLR-5 :	Acquire time management skills and expose students to the requirements of the job market			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning		
CLO-1 :	Understand the concepts of LCM, HCF, ratio and proportions, percentages and approach questions in a simpler and innovative method	3	80	70
CLO-2 :	Develop, solve, analyze, and use simple mathematical models that are relevant to daily life.	3	80	75
CLO-3 :	Solve problems on reasoning	3	85	70
CLO-4 :	Understand the different parts of speech and use them in sentences appropriately	3	85	80
CLO-5 :	Instill confidence in students and develop skills necessary to face the audience	3	85	75

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

Duration (hour)		6	6	6	6	6
S-1	SLO-1	Speed Maths and Simplification	Profit and Loss-Introduction	Number Series	Most Logical Choice	Self-Introduction - Introduction
	SLO-2	Simplification Techniques and Tricks	Profit and Loss- Basic Problems	Number Series – Solving Problems	Most Logical Choice – solving problems	Self-Introduction - Session 1
S-2	SLO-1	Divisibility	Simple Interest-Introduction, Formulas &Problems	Word Series	Logical Order	Self-Introduction - Session 2
	SLO-2	Power cycle, Reminder cycle	Compound Interest-Introduction, Formulas &Problems	Word Series – Solving Problems	Logical Order – tips and tricks	Self-Introduction - Session 3
S-3	SLO-1	Problems On H.C.F and L.C.M	Averages-Introduction& Basics	Odd man out	Synonyms	Self-Introduction - Session 4
	SLO-2	Problems On H.C.F and L.C.M Solving problems	Averages-Tricky Problems	Missing number and wrong number	Antonyms	Self-Introduction - Session 5
S-4	SLO-1	Linear and Simultaneous Equation	Algebra –Introduction	Image Based Problems-Introduction	Essential Part	Self-Introduction - Session 6
	SLO-2	Linear and Simultaneous Equation –solving problems	Algebraic Expressions Concepts	Image Based Solving Problems	Parts of Speech - Worksheets	Self-Introduction - Session 7
S-5	SLO-1	Ratio and Proportions-Introduction	Data Interpretation – Bar chart, Pie Chart	Inequalities	Spotting Error	Basics of Written Communication
	SLO-2	Ratio and Proportions-Basics Problems	Data Interpretation – Table, Line Graph	Inequalities - methods	Spotting Error –Concord, Prepositional usage, Usage of Articles	Basics of Written Communication Methods
S-6	SLO-1	Percentage -Introduction	Quadratic Equations	Coding – Decoding-Introduction	Sentence Correction – Vocabulary based	Time Management Skills
	SLO-2	Percentage- Basic problems	Quadratic Equations – Formulas and Methods	Coding – Decoding-Different types	Sentence Correction – Grammar Based	Time Management Skills - Activity

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

Learning Assessment

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

CLA-1, CLA-2 and CLA-3 can be from any combination of these: Online Aptitude Tests, Classroom Activities, Case Studies, Poster Presentations, Power-point Presentations, Mini Talks, Group Discussions, Extempore, etc.

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

Course Designers

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

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Course Code	UCD23V01T	Course Name	Universal Human Values	Course Category	V	Value Addition Course	L	T	P	0	C
							2	0	0	2	2

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

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

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	ICT Skills	Professional Behavior	Life Long Learning
CLO-1 :	Evaluate the significance of value inputs in formal education and start applying them in their life and profession	3	80	70	M	-	-	H	-	-	-	-	-	-	M	-	-	H	H
CLO-2 :	Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.	3	80	75	-	M	-	H	-	L	-	-	-	-	-	-	-	H	H
CLO-3 :	Analyze the value of harmonious relationship based on trust and respect in their life and profession	3	85	70	-	-	-	H	-	-	-	M	L	-	-	-	-	H	H
CLO-4 :	Examine the role of a human being in ensuring harmony in society and nature.	3	85	80	-	-	-	H	-	-	L	-	L	L	-	L	M	H	H
CLO-5 :	Apply the understanding of ethical conduct to formulate the strategy for ethical life and profession.	3	85	75			L	H	L	-	-	-	-	-	-	-	M	H	H

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

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

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

CLA-1, CLA-2 and CLA-3 can be from any combination of these: MCQ Tests, Classroom Activities, Case Studies, Poster Presentations, Power-point Presentations, Mini Talks, Group Discussions, Extempore, etc.

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

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
-	-	*Dr. Supraja P, UHV University Coordinator, SRMIST*
		Dr. Sathish K, HOD, Department of Career Guidance Cell, FSH, SRMIST
		Dr. Sweety Bakyarani E, Department of Computer Science, FSH, SRMIST

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SEMESTER II

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

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

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

		1	2	3
CLR-1 :	சங்க இலக்கியங்கள் வழி தொன்மை அக, புற வாழ்வியலை அறியச் செய்தல்			
CLR-2 :	தமிழ்ச்சமூகத்தின் அறவியல் குறித்து தெரியச் செய்தல்			
CLR-3 :	பக்தி இலக்கியங்கள் போதித்த மனித மாண்புகளை உணரச் செய்தல்			
CLR-4 :	பண்டைத் தமிழ்ச்சமூகத்தின் தொல் இலக்கியங்கள் வளர்ச்சி பெற்ற வரலாற்றைப் புரியச் செய்தல்			
CLR-5 :	சிறுகதைகள் சொல்லும் வாழ்வியல் நெறி, மொழியின் நுட்பங்கள் ஆகியவற்றைத் தெரியச் செய்தல்			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	பண்டைத் தமிழ்ச் சமூகத்தின் அக, புற வாழ்வியல் இன்றைய சமூக மேம்பாட்டிற்கு வழிகாட்டி நிற்பதை அறிந்துகொள்ளுதல்	2	75	60
CLO-2 :	தமிழ்ச் சமூகம் அறத்தை வலியுறுத்திய சமூகம் என்பதன் வழி மானுட அறத்தைத் தெரிந்துகொள்ளுதல்	2	80	70
CLO-3 :	பக்தி இலக்கியம் மூலம் இறைத் தந்துவங்களை அறிந்து மானுட ஒற்றுமை மேம்பாட்டை அறிந்துகொள்ளுதல்	2	70	65
CLO-4 :	தொல் தமிழ்ச்சமூகம் இலக்கியம், அரசியல், அறம், பக்தி ஆகியவற்றில் தழைத்தோங்கியதைத் தெரிந்துகொள்ளுதல்	2	70	70
CLO-5 :	வாழ்வியலின் நெறிகளைச் சொல்லும் கதைகளைப் படைக்கும் திறனோடு மொழி ஆளுமையையும் அறிந்துகொள்ளுதல்	2	80	70

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

Duration (hour)		12	12	12	12	12
S-1	SLO-1	காலந்தோறும் தமிழ் அகத்திணை மரபு	சங்க மருவிய காலம்	பல்லவர் காலம்	பண்டைக்காலத் தமிழகம்	தமிழ்ச் சிறுகதைப் போக்குகள்
	SLO-2	அக இலக்கியத்தின் கட்டமைப்பு/ உள்ளடக்கம்	அறமும் வாழ்வியலும்	பல்லவர் கால இலக்கியங்கள்	சங்ககால மக்களின் வாழ்வியல்	தமிழ்ச் சிறுகதையும் தமிழ்ச் சமூக வாழ்வியலும்
S-2	SLO-1	எட்டுத்தொகை நூல்களும் பகுப்புமுறையும்	உலகப்பொதுமறை - திருக்குறள்	பக்தியும் தமிழும்	முச்சங்கம் – அறிமுகம்	புதுமைப்பித்தன் - சங்குத்தேவனின் தர்மம்
	SLO-2	ஐங்குறுநூறு (375)	திருக்குறளின் கட்டமைப்பு	பக்தி இலக்கியத் தோற்ற நிலை	முச்சங்க வரலாறு	கள்வனின் தர்மம்
S-3	SLO-1	உடன்போக்கும் நற்றாய் புலம்பலும்	திருக்குறள் வான்சிறப்பு (2)	சைவ சமய இலக்கியங்கள்	பத்துப்பாட்டும் எட்டுத் தொகையும்	ந.பிச்சமூர்த்தி – வேப்பமரம்
	SLO-2	ஐங்குறுநூறு (391)	மழையும் வாழ்வும்	சைவக்குரவர் நால்வர்	சங்க கால மக்களின் வாழ்வியல்	மரபும் நம்பிக்கைகளும்
S-4	SLO-1	உடன் போக்கும் தமிழர் பறவையியல் அறிவும்	திருக்குறள் – புலவி நுணுக்கம்	தேவாரம் – திருஞான சம்பந்தர் - பாடல் – 2834	எட்டுத்தொகை நூல்களின் வரலாறு	தமிழருவி மணியன் – ஒற்றைச் சிறகு

	SLO-2	குறுந்தொகை (02)	ஊடலின் அழகியல்	தேவாரம் – திருநாவுக்கரசர் – பாடல் - 4262	எட்டுத்தொகை நூல்களின் கட்டமைப்பு	உறவின் மேன்மை
S-5	SLO-1	இயற்கைப் புணர்ச்சியும் தலைவி நலம் பாராட்டலும்	நீதி இலக்கியங்கள்	திருவாசகம் அறிமுகம்	பத்துப்பாட்டு நூல்களின் வரலாறு	ஆர். சூடாமணி – மூடநம்பிக்கை
	SLO-2	குறுந்தொகை (03)	நாலடியார்	மாணிக்கவாசகர் பாடல் - ஆனந்த பரவசம் – பாடல் 10	பத்துப்பாட்டும் தமிழர் வாழ்வியலும்	சமூகத்தில் மூடநம்பிக்கைகள்
S-6	SLO-1	தலைவனின் மேன்மைத் தன்மையும் இயற்கையும்	வைகலும் - பாடல் (39)	வைணவ சமயம்	பதினெண் கீழ்க்கணக்கு நூல்கள்	மூடநம்பிக்கைகளின் சிக்கல்கள்
	SLO-2	அகநானூறு (238)	நிலையாமையும் அறமும்	வைணவ சமய வளர்ச்சிப்போக்கு	பதினெண் கீழ்க்கணக்கும் தமிழர் அற மரபும்	கிருஷ்ணா டாவின்ஸி – காலா அருகே வாடா
S-7	SLO-1	இயற்கையும் அகவாழ்வுச் சித்திரிப்பும்	தமிழர் மருத்துவம்	நாலாயிரத் திவ்யப் பிரபந்தம்	நீதி இலக்கியங்கள்	மனித வாழ்வில் மருத்துவம்
	SLO-2	நள்ளியின் கொடைத்திறம்	நீதி இலக்கியத்தில் மருந்து நூல்கள்	குலசேகராழ்வார் பாடல் - 678	நீதி இலக்கியங்களின் பன்முகத் தன்மைகள்	பாரம்பரிய மருத்துவம்
S-8	SLO-1	கலித்தொகைப் பாடல் –(11)	சிறுபஞ்சமூலம் (64)	ஆண்டாள் பாடல் – 574.	காப்பிய இலக்கணம்	மொழிப்பயிற்சி
	SLO-2	அறம் பொருள் இன்பம் சிறப்பு	ஈகையின் சிறப்பு	திருமழிசை ஆழ்வார் பாடல் – கணிகண்ணன்	காப்பியத்தின் போக்குகள்	சொற்களை உருவாக்குதல்
S-9	SLO-1	சூழலியலும் மனித வாழ்வும்	பழமொழி நானூறு அறிமுகம்	தமிழில் இஸ்லாமிய இலக்கியங்கள்	காப்பியங்களின் வகைமை	எழுத்துகளில் இருந்து சொற்களைக் கண்டுபிடித்தல்
	SLO-2	தமிழர் புறமரபு	பழமொழி நானூறு – தனித்தன்மைகள்	இஸ்லாமிய இலக்கியங்களின் கொடை	ஐம்பெருங்காப்பியங்களின் தனித்தன்மைகள்	படம் பார்த்துக் கதை எழுதுதல்
S-10	SLO-1	புறநானூறு (107) பாரியும் மாரியும்	பழமொழி நானூறு (184)	சீறாப்புராணத்தின் அமைப்பு	தமிழ்ச் சமூகமும் சமயத் தத்துவங்களும்	படம் பார்த்துக் கவிதை எழுதுதல்
	SLO-2	புறநானூறு (110) பாரியின் வள்ளல் தன்மை	பழமொழியும் அறிவுரையும்	விடமீட்டப் படலம் (10 பாடல்கள்)	சமயத் தத்துவங்களும் வாழ்வியல் விழுமியங்களும்	கற்பனைத்திறன் – வளர்த்தல்
S-11	SLO-1	புறநானூறு (112) கையறுநிலை	பண்டைக்காலப் போரும் வாழ்வும்	கிறித்தவ சமய இலக்கியங்கள்	சைவத் திருமுறை – அறிமுகம்	கற்பனையும் படைப்பும்
	SLO-2	சிறுபாணாற்றுப்படை (84-115)	புற இலக்கியங்கள்	கிறித்தவ இலக்கியங்களின் தமிழ்க் கொடை	பன்னிரு திருமுறை – வரலாறு	தமிழில் வாசகம்
S-12	SLO-1	கடையெழு வள்ளல்களின் சிறப்புகள்	களவழி நாற்பது (40)	கிறித்துவின் அருள்வேட்டல் – திரு.வி.க	நாலாயிரத் திவ்வியப் பிரபந்தம் – அறிமுகம்	விளம்பரத்திற்கு வாசகம் எழுதுதல்
	SLO-2	பட்டினப்பாலை (40-50) அட்டில் சாலைகளின் நிலை	போர்க்களமும் யானைப்படையும்	அலகிலொளி – 5 பாடல்கள்	வைணவ ஆழ்வார்கள் வரலாறு	வாசகம் எழுது முறைகள்

Learning Resources	1. கொன்றை, தொகுப்பும் பதிப்பும் - தமிழ்த்துறை ஆசிரியர்கள், தமிழ்த்துறை, எஸ்.ஆர்.எம். அறிவியல் மற்றும் தொழில்நுட்பக் கல்விநிறுவனம், காட்டாங்குளத்தூர், 603203, 2023 2. தமிழண்ணல், புதிய நோக்கில் தமிழ் இலக்கிய வரலாறு, மீனாட்சி புத்தக நிலையம், மதுரை, 2017 3. மு. அருணாசலம், தமிழ் இலக்கிய வரலாறு, நூற்றாண்டு முறை (9ஆம் நூ. முதல் 16 வரை), தி பார்க்கர், சென்னை, 2005 4. தமிழ் இணையக் கல்விக்கழகம் - http://www.tamilvu.org/ 5. மதுரை தமிழ் இலக்கிய மின் தொகுப்புத் திட்டம் - https://www.projectmadurai.org/

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

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

Course Designers		
Experts from Industry	Expert from Higher Technical Institutions	Internal Experts
1. Dr. P.R.Subramanian, Director, Mozhi Trust, Thiruvanmiyur, Chennai – 600 041.	*1. Dr. V. Dhanalakshmi, Associate Professor, Subramania Bharathi School of Tamil Language & Literaturel, Pondicherry University, Pondicherry*	*1. Dr. B.Jaiganesh, Associate Professor & Head, Dept. of Tamil, FSH, SRMIST*
		2. Dr. R. Ravi, Assistant Professor and Head, Dept. of Tamil, FSH, SRMIST, VDP.
		3. Mr. G. Ganesh, Assistant Professor, Dept. of Tamil, FSH, SRMIST, RMP.
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		5. Dr. S.Saraswathy, Assistant Professor, Dept. of Tamil, FSH, SRMIST, KTR.

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Course Code	ULH23G02J	Course Name	HINDI-II	Course Category	G	Generic Elective Course	L	T	P	O	C
							2	0	2	2	3

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

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

		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 :	They get to learn Ancient ,Medieval,and Modern poetry	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLR-2 :	To understand the Significance of poems of great poets like Kabir,Tulsidas,Bihari and Dhananand																		
CLR-3 :	To Enhance and Enrich their knoeledge through poetry																		
CLR-4 :	Media based understanding for employability																		
CLR-5 :	Job Oriented writing skills																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1 :	To provide a brief Introduction of Hindi poetry(Bhaktikal,Reetikal and Aadhunikkal)	2	75	80	H	H	H	M	L	H	L	M	L	L	H	M	-	-	-
CLO-2 :	To Discuss the origin and development of various forms of poetry in Hindi	2	80	90	H	H	H	M	L	H	H	M	L	L	H	M	-	-	-
CLO-3 :	Focus on Evaluating the social changes through poetry	2	75	95	H	H	M	L	H	H	M	H	M	M	H	H	-	-	-
CLO-4 :	To Examine Transcreation in advertisement	2	80	90	H	H	L	H	M	H	L	H	H	M	H	H	-	-	-
CLO-5 :	To guide the students in the learning of the technical aspect of the Hindi Languge,this would help them in the field administration	2	85	90	M	H	M	H	L	H	H	L	H	M	H	H	-	-	-

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

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

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

Learning Assessment

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

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

Course Designers

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

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

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

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

		1	2	3
CLR-1 :	Strengthen the language of the students both in oral and written	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	Express their sentiments, emotions and opinions, reacting to information, situations			
CLR-3 :	Make them learn the basic rules of French Grammar.			
CLR-4 :	Develop strategies of comprehension of texts of different origin			
CLR-5 :	Enable the students to overcome the fear of speaking a foreign language and take position as a foreigner speaking French			

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

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

S-12	**SLO-1**	Les exemples	Grammaire –Communication	La phrase négative (2	Les fêtes	Parler au téléphone
	SLO-2	Les activités	Les activités	Les exemples	Les messages	Un coup de fil

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

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

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

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

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

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

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

		Learning			Program Learning Outcomes (PLO)														
CLR-1 :	*To create awareness on Environment and Renewable and Non-renewable resources*	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	*To understand about ecosystem and Biodiversity*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	ICT Skills	Professional Behavior	Life Long Learning
CLR-3 :	*To understand the natural and anthropogenic impact of the environmental pollution*																		
CLR-4 :	*To create awareness on different environmental problems*																		
CLR-5 :	*To create awareness on various Environment Protection acts and the impact of human population on environment*																		

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1 :	*Applying knowledge on Renewable and Non-renewable resources*	2	80	65	L	H	L	M	L	H	L	L	L	H	L	M	-	-	M
CLO-2 :	*Understanding about ecosystem and Biodiversity*	2	80	70	M	H	L	M	L	H	L	L	L	H	L	M	-	-	M
CLO-3 :	*Gathering knowledge on impact of environmental pollution*	2	80	70	L	H	L	M	L	H	M	M	M	H	L	M	-	-	M
CLO-4 :	*Understanding of different environmental problems*	2	80	70	M	H	L	M	L	H	M	M	M	H	L	M	-	-	M
CLO-5 :	*Having knowledge on various Environment Protection acts and the impact of human population on environment problems*	2	80	65	M	H	L	M	L	H	L	M	L	H	L	M	-	-	M

Duration (hour)		9	9	9	9	9
S-1	**SLO-1**	*Multidisciplinary nature of environmental studies*	*Energy flow in the ecosystem*	*Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity*	*Disaster management- Nature Floods, Earthquakes*	*Environment Protection Act*
	SLO-2	*Definition, Scope and Importance of Environmental Studies*	*Energy flow in the ecosystem*	*Environmental Pollution- Definition*		*Air (Prevention and Control of Pollution) Act*
S-2	**SLO-1**	*Need for public awareness.*	*Ecological succession*	*Causes, Effects and Control Measures of Air Pollution*	*Cyclones Landslides*	*Water (Prevention and control of Pollution) Act*
	SLO-2	*Institutions in Environment*	*Food chains, Food webs and Ecological pyramids*			*Wildlife Protection Act*
S-3	**SLO-1**	*People in Environment*	*Ecosystem, Introduction, Types, Characteristic features, Structure and functions*	*Causes, Effects and Control Measures of Water Pollution*	*Social Issues and the Environment: From Unsustainable to Sustainable Development*	*Forest Conservation Act*
	SLO-2	*Introduction to natural resources- Associated Problems*	*Forest ecosystem*			*Issues involved in enforcement of environmental legislation*
S-4	**SLO-1**	*Renewable and Nonrenewable resources*	*Grassland ecosystem*	*Causes, Effects and Control Measures of Soil Pollution*	*Urban problems related to energy*	*Public awareness*
	SLO-2	*Forest resources*	*Desert ecosystem*		*Water Conservation*	
S-5	**SLO-1**	*Water Resources*	*Aquatic ecosystems (ponds, lakes, streams)*	*Causes, Effects and Control Measures of Marine pollution*	*Rain Water Harvesting, Watershed*	*Human Population and the Environment: Population growth, variation among nations*
	SLO-2	*Mineral Resources*	*Aquatic ecosystems (rivers, estuaries, oceans)*			
S-6	**SLO-1**	*Food Resources*	*Biodiversity and its conservation- genetic, species and ecosystem diversity*	*Causes, Effects and Control Measures of Noise Pollution*	*Environmental Ethics: Issues and Possible Solutions*	*Population explosion – Family Welfare Programme*
	SLO-2	*Energy Resources*	*Biogeographical classification of India*			*Environment and human health*
S-7	**SLO-1**	*Land Resources*	*Value of Biodiversity*			*Human Rights*

	SLO-2	*Role of an individual in conservation of natural resources*	*Biodiversity at Global, National and Local Levels*	*Causes, Effects and Control Measures of Thermal Pollution*	*Climate change & Global warming*	*Value Education*
S-8	**SLO-1**	*Equitable use of resoureces for sustainable lifestyles*	*India as a Mega Diversity Nation*	*Causes, Effects and Control Measures of Nuclear hazards*	*Acid rain & Ozone layer depletion*	*HIV/AIDS*
	SLO-2	*Concept of an ecosystem*	*Hot-spots of biodiversity*			
S-9	**SLO-1**	*Structure and Functions of an ecosystem*	*Threats to biodiversity: habitat loss, poaching of wildlife man-wildlife conflicts*	*Solid Waste Management Causes, Effects and Control Measures of Urban and Industrial Waste*	*Nuclear Accidents and Nuclear Holocaust*	*Women and Child Welfare*
	SLO-2	*Producers, consumers and decomposers*	*Endangered and endemic species of India*	*Role of Individuals In Pollution Prevention*	*Wasteland Reclamation*	*Role of Information Technology in Environment and human health*

Learning Resources	**Theory:** 1. Bharucha Erach, (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. 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

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

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

Course Designers

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

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Course Code	UPY23201J	Course Name	Electricity and Magnetism	Course Category	C	Professional Core Course	L	T	P	O	C
							3	0	3	2	4

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning
CLR-1 :	*understand how electromagnetic interactions can be understood using forces and fields*	1
CLR-2 :	*familiarize with numerically solving the problems arising electricity and magnetism*	
CLR-3 :	*acquire skills on mathematically handling fields.*	
CLR-4 :	*acquire numerical skills on solving problems involving charges, currents and fields.*	
CLR-5 :	*use the knowledge of electric and magnetic fields to get basic ides of electromagnetic radiation*	

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*represent electromagnetic interaction in terms of forces and fields.*	2	75	60
CLO-2 :	*apply mathematical tools to explain electromagnetic interactions.*	2	80	70
CLO-3 :	*solve problems in engineering related to charges and currents.*	2	70	65
CLO-4 :	*solve problems in electromagnetism that require numerical approach.*	2	70	70
CLO-5 :	*device and run experiments based on demonstration of electromagnetic phenomenon*	2	80	70

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

Duration (hour)		18	18	18	18	18
S-1	SLO-1	*Geometrical interpretations of divergence and curl*	*E field of continuous charge distribution*	*Uniqueness theorems*	*Line, surface and volume current densities*	*Ampere's law in magnetized materials*
	SLO-2	*Geometrical interpretations of divergence and curl*	*Problems/Demos/ Simulations/Seminars on E field of discrete charge distributions*	*Method of images for calculating potentials*	*Law of conservation of charges and continuity equation*	*One basic numerical problem on the field due to a magnetized object*
S-2	SLO-1	*Line and surface integrals*	*Divergence of electrostatic field*	*Method of images for calculating potentials*	*Steady currents and continuity equation*	*Magnetic susceptibility and permeability*
	SLO-2	*Volume integrals*	*Gauss's law and its importance*	*Numerical problems to calculate potential of systems using method of images*	*Biot Savart law, magnetic field due to steady straight-line currents*	*Ferromagnetism*
S-3	SLO-1	*Geometrical interpretation of fundamental theorem on gradients*	*Applications of Gauss's law*	*Multipolar expansion*	*Divergence of magnetic field*	*Ohm's law*
	SLO-2	*Geometrical interpretation of fundamental theorem on divergences*	*Problems involving Gauss's law to calculate electrostatic fields*	*Monopole and Dipole Terms*	*Curl of magnetic field and Ampere's law*	*Emf and motional emf*
S-4 to S-6	SLO-1	*Introduction to the Laboratory*	*Determination of Internal resistance of the given cell using Potentiometer*	*Repeat/Revision of Experiments*	*Determination of Figure of merit of charge by Ballistic Galvanometer*	*Study of resonance in series LCR circuits.*
	SLO-2					
S-7	SLO-1	*Geometrical interpretation of fundamental theorem on curls.*	*Curl of Electrostatic field*	*Dielectrics and induced dipoles*	*Applications of Ampere's law*	*Faraday's law and induced electric field*
	SLO-2	*Numerical problems in all 3 fundamental theorems.*	*Conservative nature of electrostatic field and scalar electric potential*	*Polarization and bound charges, Physical interpretation of bound charges*	*Applications of Ampere's law*	*Energy in magnetic fields*
S-8	SLO-1	*Spherical polar coordinate system (SPC)*	*Importance of scalar electric potential.*	*Field inside a dielectric*	*Field due to solenoid*	*Maxwell's modification of Ampere's law*
	SLO-2	*Calculate the volume of sphere in SPC*	*Boundary conditions*	*Gauss's law in the presence of dielectrics and electric displacement*	*Field due to infinite sheet of current*	*Displacement current*
S-9	SLO-1	*Cylindrical polar coordinate system (CCS)*	*Poisson's and Laplace's equations*	*Boundary conditions*	*Magnetic vector potential*	*Boundary conditions*
	SLO-2	*Equations for Gradient, divergence and curl in SPC and CC.*	*Potential of localized charge distribution*	*Field inside a dielectric*	*Magnetostatic boundary conditions*	*Transverse and longitudinal polarization*

S-10 to S-12	**SLO-1**	*Calibration of Voltmeter using Potentiometer*	*Determination horizontal component of earth magnetic field-Field along the axis of the coil*	*Determination of Magnetic moment and Ratio of magnetic moments by Searle's vibration magnetometer method.*	*EMF of thermocouple Potentiometer*	*Study of resonance in parallel LCR circuits.*
	SLO-2					
S-13	**SLO-1**	*Dirac Delta function, Importance of Dirac delta function in electrostatics*	*Energy of a point charge distribution*	*Calculating the electric field of dielectric objects using Gauss's law*	*Simple problem in calculation of vector potential*	*The wave equation for E and B in vacuum*
	SLO-2	*One dimensional Dirac delta function*	*Energy of a continuous charge distribution*	*Susceptibility, permittivity and dielectric constant*	*Magnetization*	*Solution of the wave equation*
S-14	**SLO-1**	*Helmoltz theorem and potentials*	*Basic properties of Conductors*	*Susceptibility tensor*	*torque and force on magnetic dipoles*	*Transverse nature of EM waves*
	SLO-2	*Scalar and vector potentials*	*Induced charges, Capacitors*	*Current and magnetic field*	*torque and force on magnetic dipoles*	*Energy and momentum in EM waves*
S-15	**SLO-1**	*Coulomb's law*	*Laplace's equation in 1D, 2D and 3D*	*Magnetic force: Lorentz force law*	*Field of a magnetized object*	*Continuity equation, Poynting's theorem*
	SLO-2	*E field of discrete charge distributions*	*Laplace's equation in 1D, 2D and 3D*	*Cycloid motion, Numerical Problems/Demos/ Simulations/Seminars on magnetic force and cycloid motion*	*Bound currents and its physical interpretation*	*Poynting vector and intensity of EM waves*
S-16 to S-18	**SLO-1**	*Calibration of Ammeter using Potentiometer*	*Determination of Temperature Coefficient of Resistance using Post Office Box*	*Comparison of EMFs of two cells using Ballistic Galvanometer*	*Comparison of Capacitance of two capacitors using Ballistic Galvanometer.*	*Repeat/Revision of Experiments*
	SLO-2					

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

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

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. M Sathish , CSIR-CECRI, msathish@cecri.re.in	Prof. VS Subramanian, IIT Madras, manianvs@iitm.ac.in	Dr. Rohitdhir, SRMIST
Dr. DK Aswal , NPL, dkaswal@nplindia.org	Prof. C Venkateshwaran, University of Madras, venkateshwaran@unom.ac.in	Dr. K Shadak Alee, SRMIST

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Course Code	UPY23202J	Course Name	Mathematical Physics-II	Course Category	C	Professional Core Course	L	T	P	O	C
							3	0	2	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:
CLR-1 :	solve the complex problems easily using tensorial method
CLR-2 :	apply the special functions to various fields of applied physics
CLR-3 :	express and transformed the periodic functions using integral transforms
CLR-4 :	learn about the curve fitting
CLR-5 :	learn to draw inferences of the physical equations

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning 1 Level of Thinking (Bloom)	Learning 2 Expected Proficiency (%)	Learning 3 Expected Attainment (%)
CLO-1 :	introduce advanced mathematical methods in physics and their applications.	2	75	60
CLO-2 :	use mathematical concepts required in physics	2	80	70
CLO-3 :	develop expertise in solving the complex problems in physics.	2	70	65
CLO-4 :	develop the skill to solve and express the advanced mathematics	2	70	70
CLO-5 :	able to resolve the unsolved and complex theoretical works in physics	2	80	70

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

Duration (hour)		15	15	15	15	15
S-1	SLO-1	Tensors analysis	Calculus of Residue	Partial Differential equations	Special functions	Integral transforms and Integral equations - Development of the Fourier integral
	SLO-2	Introduction, definitions	Basics	Introduction, definitions	Series solutions-Frobenius method	inversion theorem
S-2	SLO-1	definitions	Zeros Singular points	Derivative of partial deferential equation	second solution	inversion theorem
	SLO-2	Contraction	Poles	Linear partial deferential equation of order one	second solution	Fourier transform
S-3	SLO-1	direct products	essential singularity	Lagrange's Linear equation	Hermite function	Fourier transform
	SLO-2	direct products	Evaluation of residues	Lagrange's solution of Linear equation	Hermite function	Laplace transforms
S-4 to S-5	SLO-1 / SLO-2	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars
S-6	SLO-1	quotient rule	Cauchy Residue theorem	Geometrical interpretation of Lagrange's linear equation	Hermite differential equation	Laplace transforms
	SLO-2	pseudo tensors	Cauchy Principal value	Geometrical interpretation of Lagrange's linear equation	Legendre and associated Legendre functions	properties of Laplace transform
S-7	SLO-1	irreducible tensors	Cauchy Principal value	the linear equation with n independent variables	Legendre and associated Legendre functions	properties of Laplace transform
	SLO-2	irreducible tensors	Cauchy Principal value	the linear equation with n independent variables	Legendre equation	inverse Laplace transformation. Fourier integral Theorem
S-8	SLO-1	Levi-Civita symbol	evaluation of definite integrals and contour integrals	special type of equations	Legendre equation	inverse Laplace transformation. Fourier integral Theorem
	SLO-2	Levi-Civita symbol	evaluation of definite integrals and contour integrals	Standard 1: equations of the form f(p,q)=0	Legendre equation	Fredholm equations
S-9 to S-10	SLO-1 / SLO-2	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars
S-11	SLO-1	irreducible tensors	evaluation of definite integrals and contour integrals	Standard 4 : equations of the form z=px+qy+f(p,q)	Legendre equation	Fredholm equations

	SLO-2	*irreducible tensors*	*evaluation of definite integrals and contour integrals*	*Standard 2 : equations of the form f(z,p,q)=0*	*Legendre equation*	*Volterra equations of first and second kind*
S-12	**SLO-1**	*non-Cartesian tensors metric tensor*	*evaluation of definite integrals and contour integrals*	*Standard 3 : equations of the form f(x,p)=f(y,q)*	*Legendre equation*	*Volterra equations of first and second kind*
	SLO-2	*Christoffel symbols*	*dispersion relation*	*Standard 3 : equations of the form f(x,p)=f(y,q)*	*Bessel's function*	*Volterra equations of first and second kind*
S-13	**SLO-1**	*Christoffel symbols*	*dispersion relation*	*General method of solution*	*Bessel's function*	*transformation of a differential equation into an integral equation (without devitation).*
	SLO-2	*covariant differentiation*	*dispersion relation*	*homogeneous linear equations with constant coefficients*	*Bessel's function*	*transformation of a differential equation into an integral equation (without devitation).*
S-14 to S-15	**SLO-1**	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2					

Learning Resources

1. G. Arfken and H.J. Weber, *Mathematical Methods for Physicists*, 6th Ed., Academic Press, SanDiego, 2005.
2. P.K. Chattopadhyay, *Mathematical Physics*, Wiley Eastern, New Delhi, 2005.
3. C. Harper, *Introduction to Mathematical Physics*, Prentice Hall of India, New Delhi, 2004.
4. M.R. Spiegel, *Schaum's Outline of Advanced Mathematics for Engineers and Scientists*, 1st Ed., McGraw Hill, 2009.
5. P.K. Chattopadhyay, *Mathematical Physics*, 1st Ed., New Age International, 2009.
6. L.A. Pipes, *Applied Mathematics for Engineers and Physicists*, McGraw-Hill, 1958.
7. M.L. Boas, *Mathematical Methods in the Physical Sciences*, 3rd Ed., John Wiley, 2005.
8. M.R. Spiegel, Seymour Lipschutz, John J. Schiller, and Dennis Spellman, *Schaum's outline of Complex Variables*, 2nd Ed., McGraw Hill, 2009.
9. B.D. Gupta, *Mathematical Physics*, 4th Ed., Vikas Publishing House, 2009.
10. S. Hassani, *Mathematical Physics: A Modern Introduction to Its Foundations*, 2nd Ed., Springer, 2013.

Learning Assessment

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

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

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. R. Seshadri , Titan company ltd, seshadri@titan.co.in	*Dr. Ranjit Kumar Nanda, IIT Madras, nandab@iitm.ac.in*	*Dr. Sanjay Mehta, SRMIST*
2. Dr. D. K. Aswal , NPL, dkaswal@nplindia.org	Prof. C. Vijayan, IIT Madras, cvijayam@iitm.ac.in	*Dr. Alok Kumar, SRMIST*

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Course Code	UPY23203J	Course Name	Heat and Thermodynamics	Course Category	C	Professional Core Course	L	T	P	O	C
							3	0	3	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
CLR-1 :	Know the fundamentals of heat, specific heat of solids, liquids and gases	1
CLR-2 :	Understand the methods of transmission of heat and thermal conductivities	2
CLR-3 :	Realize the importance of kinetic theory of gases	3
CLR-4 :	Learn the laws of thermodynamics and its significance	
CLR-5 :	Recognize the concepts of entropy and Learn the Maxwell's thermodynamical relations	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Fundamental Knowledge	Application of Concepts	Link with Related	Procedural Knowledge	Skills in Specialization	Ability to Utilize	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	Understand the methods to determine the specific heat capacities of solids, liquids and gases	2	75	60	H	H	-	-	-	H	-	-	-	-	-	-	-	-	-
CLO-2 :	Grasp concepts of thermal conductivities in different media	2	80	70	H	H	-	-	-	H	-	-	-	-	-	-	-	-	-
CLO-3 :	Realize the importance of black body radiation and its importance	2	70	65	H	H	-	-	-	H	-	-	-	-	-	-	-	-	-
CLO-4 :	Comprehend the knowledge of kinetic theory of gases and their properties, Van der Waals constants, critical constants and importance	2	70	70	H	M	-	-	-	M	-	-	-	-	-	-	-	-	-
CLO-5 :	Familiarize with the laws of thermodynamics, entropy and its implications in real life applications	2	80	70	H	H	-	-	-	M	-	-	-	-	-	-	-	-	-

Duration (hour)		18	18	18	18	18
S-1	SLO-1	Introduction to heat - Specific heat	Transmission of heat - Conduction, Convection	Kinetic theory of gases - Postulates of kinetic theory of gases	Laws of thermodynamics- Zeroth Law of Thermodynamics and Concept of Temperature	Concept of entropy
	SLO-2	Thermal capacity, water equivalent	Coefficient of the thermal conductivity	Expression for the pressure of a gas- Mean, RMS, Most Probable Speeds	First law of thermodynamics its differential form- Internal Energy	Concept of entropy
S-2	SLO-1	Newton's law of cooling –	Rectilinear flow of heat along a metal bar	Degrees of freedom , Maxwell's law of equipartition of energy	Isothermal process.	Clausius Inequality
	SLO-2	Specific heat capacity of unknown liquid using Newton's law of cooling	Rectilinear flow of heat along a metal bar	Atomicity of gases – monoatomic gas	Adiabatic process.	Second law of thermodynamics in terms of Entropy
S-3	SLO-1	Specific heat of a liquid – Joule's electrical method	Forbes' method to find K	Maxwell's law of distribution of molecular velocities	Application of first law of themodynamics – Specific heat of a gas Cp, Cv relation	Third law of thermodynamics
	SLO-2	Specific heat of a liquid – Joule's electrical method	Forbes' method to find K	Maxwell's law of distribution of molecular velocities - Equilibrium speed distribution of velocities	Gas equation during an adiabatic process	Principle of Increase of Entropy -Unattainability of Absolute Zero
S-4 to S-6	SLO-1	Basics of Experiments	Determination of Specific Heat Capacity of the liquid using Joule's calorimeter.	Revision/Repeat classes	Revision/Repeat classes	Revision/Repeat classes
	SLO-2					
S-7	SLO-1	Introduction to specific heats of at constant pressure	Lee's disc method to find thermal conductivity of bad conductor	Mean free path	Work done during an Isothermal process	Change in entropy in a reversible process
	SLO-2	Introduction to specific heats of at constant pressure	Lee's disc method to find thermal conductivity of bad conductor	Determination of Mean free path	Work done during an Isothermal process	Change in entropy in an irreversible process
S-8	SLO-1	Cp,Cv relation	Methods of radial flow of heat Spherical shell method and flow of	Transport phenomena	Work done during an adiabatic process	Entropy Vs Temp

			heat along the wall of a cylindrical tube			
	SLO-2	Specific heat of a gas at Cv by Jolly's differential steam calorimeter	Methods of radial flow of heat Spherical shell method and flow of heat along the wall of a cylindrical tube	Diffusion of gases	Work done during an adiabatic process	Temperature entropy diagram
S-9	SLO-1	Specific heat of a gas at Cp - Regnault's method	Radiation - Black body	Viscosity of gases	Reversible process	Entropy of perfect gas
	SLO-2	Specific heat of a gas at Cp - Regnault's method	Black body	Viscosity of gases	Irreversible process	Thermodynamic Potentials: Internal Energy
S-10 to S-12	SLO-1	Determination of Specific Heat Capacity of the liquid using Newton's Law of Cooling	Determination of Specific heat capacity of a solid by Method of mixtures. (Half time correction).	Determination of Thermal conductivity of a good conductor using Forbes method.	Determination of Stefan's constant	Determination of Planck's constant using black body radiation.
	SLO-2					
S-13	SLO-1	Dulong and Petit's law	Rayleigh's Law and its significance	Andrew's Experiments on CO2 Gas- Critical Constants	Second law of thermodynamics – Kelvin -Planck statement	Enthalpy
	SLO-2	Variation of specific heat and atomic heat with temperature	Jean's law	Andrew's Experiments on CO2 Gas- Critical Constants	Second law of thermodynamics – Clausius statement	Helmholtz Free Energy,
S-14	SLO-1	Einstein's theory of specific heat	Wein's displacement Law	Van Der Waals equation of state	Conversion of Work into Heat and Heat into Work	Gibb's Free Energy
	SLO-2	Einstein's theory of specific heat	Stefan's law	Van Der Waals equation of state	Concept of Carnot's engine	Maxwell's thermodynamical relations
S-15	SLO-1	Debye's theory of specific heat	Planck's law	Relation between Van der Waal's constant and critical constants	Working efficiency of Carnot's engine	Maxwell's thermodynamical Relations - Significance
	SLO-2	Debye's theory of specific heat	Experimental Determination of Stefan's constant	Coefficient of Van der Waals constant	Working efficiency of Carnot's engine	Joule-Kelvin coefficient for Ideal and Van der Waal Gases
S-16 to S-18	SLO-1	Determination of Specific Heat Capacity of the liquid using Joule's calorimeter.	Determination of Thermal conductivity of a bad conductor using Lee's disc method.	Determination of thermal conductivity of good conductors by Searle's method.	Calculate the Temperature coefficient of resistance of the given coil by Carey Foster Bridge.	Revision/Repeat classes
	SLO-2					

Learning Resources	1. *Heat, Thermodynamics and Statistical Physics, Brijlal, N. Subrahmanyam and P. S. Hemne (S. Chand and Company, 2010).* 2. *Heat and Thermodynamics by Richard H Dittman and Zemansky M.W. (McGraw Hill,2008).*	3. *Heat and Thermodynamics by D.S. Mathur (S. Chand and Company, 2006).* 4. *Thermal Physics by Kittel C and Kroemer H, W. H. (Free man and Company, New York 1980).* 5. *Concepts in Thermal Physics by Stephen Blundell and Katherine M. Blundell (Oxford University Press, 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 / Understand	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Level 2	Apply / Analyze	40%	40%	50%	50%	50%	50%	50%	50%	50%	50%
Level 3	Evaluate / Create	30%	30%	20%	20%	20%	20%	20%	20%	20%	20%
	Total	100 %		100 %		100 %		100 %		100 %	

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

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Dr. M Satish, CSIR-CECRI, msathish@cecri.res.in	*Dr. G Kalpana, Anna University, g_kalpa@annauniv.edu*	*Dr.C. P. Kala, SRMIST*

Course Code	UCD23S02T	Course Name	Verbal Ability and Skill Development	Course Category	S	*Skill Enhancement Course*	L	T	P	O	C
							2	0	0	2	2

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning
CLR-1 :	*Critically evaluate basic mathematical concepts related to mixtures and alligations, Numbers, time and work*	1
CLR-2 :	*Use their logical thinking and analytical abilities to solve reasoning problems*	2
CLR-3 :	*Develop soft skills relating to the need for job recruitment*	3
CLR-4 :	*Provide students with the necessary skills to generate and interpret data sufficiency, problems on Chain Rule, Pipes and Cisterns, Boats and streams,*	
CLR-5 :	*Enable students to understand problems on graphs and also increase their ability in language skills*	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	ICT Skills	Professional Behaviour	Life Long Learning
CLO-1 :	*Understand the concepts of mixtures and alligations, Numbers, time and work and to approach questions in a simpler and innovative method*	3	80	70	M	H	-	L	-	M	-	M	M	H	-	H	-	-	-
CLO-2 :	*Establish a student's interest and awareness in seating arrangements, mathematical operations, logical reasoning*	3	80	75	M	H	-	L	-	M	-	M	M	H	-	H	-	-	-
CLO-3 :	*Acquire soft skills that will help for applying jobs*	3	85	70	-	-	M	H	M	-	L	-	-	-	H	-	M	M	H
CLO-4 :	*Demonstrate various principles involved in aptitude problems*	3	85	80	-	-	-	-	M	-	L	H	-	H	-	H	-	-	L
CLO-5 :	*Ability to solve problems on reasoning and to interpret English language*	3	85	75	-	H	-	L	-	H	-	M	M	-	H	--	M	-	M

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

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

Learning Assessment

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

CLA-1, CLA-2 and CLA-3 can be from any combination of these: Online Aptitude Tests, Classroom Activities, Case Studies, Poster Presentations, Power-point Presentations, Mini Talks, Group Discussions, Mock interviews, etc.

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

Course Designers

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

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

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

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

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

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Introduction to Listening Skills.	Introduction to Reading Skills. Discussion of techniques of Reading Skill	Introduction to Speaking Skills. Explaining the importance of phonetics and vocabulary	Introduction to Writing Skills Importance of writing skills	Introduction to appreciation of texts.
	SLO- 2	Exploring Effective Ways of Listening. Barriers of Listening. Active and Passive Listening.	Identifying common reading problems in students after making them read a few passages.	Explaining the usage of the Oxford Learner's Dictionary to learn phonetics of the words at the fundamental level.	Explaining various forms of writing with examples:.	Encouraging the students to share a few of their favourite lines from any sources they have read or sharing a few lines from paditthadhil piditthadhu.
S-2	SLO-1	Introduction to Digital language lab/ usage of mobile applications	Learners are enabled to record their speech and listen to it in order to correct their problematic areas	The right enunciation of certain words to be taught through phonetic representation and decoding the phonetic symbols by learning to use the dictionary..	Introduction to letter writing. Types of letters- Formal and Informal letters with examples. Learning E-mail etiquette.	Explaining why appreciating texts creates a good reader.
	SLO- 2	Equipping the listening skill of the learners	repetitive practices of reading select paragraphs from web resources, their standard will be measured.	Observe and repeat and learn the phonetic pronunciation of words by practicing continuously.	Class Assignment - write a formal letter and informal letter and check for e-mail etiquettes in writing.	Enabling the students to reflect in the classroom about any of their favourite books/ articles or magazines.
S-3 – S-4	SLO-1	Introducing google podcasts.	The speed, fluency, pronunciation, comprehension of the words in the paragraph	Teaching the usage of Thesaurus to understand and develop various words and improve vocabulary.	Enabling the students to unleash their potentials in creative writing	Introducing the text of Letters by Mathrubootham

					through writing transcripts for advertisements of any product.	*published in the Hindu.*
	SLO- 2	*Task to write down the words from the audio they have listened to. This activity should be done in two steps. 1. Jotting down the words simultaneously as they listen to the speaker. 2. Writing the transcript of the audio through repetitive play and pause.*	*hints and tricks to follow where the pauses are to be followed.*	*Identifying common errors in concord, preposition, direct speech and indirect speech.*	*write a review of any book or a movie or an interview or a debate.*	*Reading and recitation of the text of the first letter-Enjoy within limits, says Mr. Mathrubootham* *Understanding characters by analyzing the usage of their style of language*
S-5	**SLO-1**	*Imitating the speakers by listening to them and attempting to learn the pronunciation of the words uttered in the audio.*	*Students group 1- reads – group 2 identifies the flaws in reading.*	*Identifying common errors in tenses, punctuation, and syntactical errors..*	*Mechanics of writing like capitalization, punctuation, spelling, correct pronoun, preposition, concord usage can be taught.*	*Reading of the second letter-* *Nobel? What Nobel, asks Mr. Mathrubootham.*
	SLO- 2	*Repetitive listening to enhance pronunciation skills*	*The roles have to be exchanged between the two groups and the activity should be practiced.*	*Rectifying the common errors and instructing the learners about the right usage in order to avoid common errors.*	*meachnaics of writing - assessed and evaluated.*	*Mathrubootham's humour and the language of code switching from Tamil to English and vice – versa.*
S-6	**SLO-1**	*Introducing to the audios of TED TALK American Speakers. Listening to the native speakers of English Language through TED TALKS.*	*Identify the key arguments in a passage -introductory point, lead point, supportive argument statement, concluding point and the common connecting word between all the key words in the passage.*	*Practicing how to avoid common errors.*	*Teaching effective writing by learning to avoid common errors in concord, preposition, conjunction, relative pronouns, question tags.*	*Reading of the third letter -Mr. Mathrubootham is fully supporting all new technologies*
	SLO- 2	*Introducing to the audios of TED TALK British Speakers. Listening to the native speakers of English Language through TED TALKS.*	*encouraged to identify the key arguments in other passages on their own.*	*The learners are introduced to collocations for quick choice of learning how to speak in short time and how to speak effectively.*	*Practicing effective writing by learning to avoid common errors in concord, preposition, conjunction, relative pronouns, question tags.*	*Mathrubootham's frustration over the failure of technologies and the language that he positively uses to denote hopelessness over technologies.*
S-7 – S-8	**SLO-1**	*American and British styles can be differentiated.*	*Guiding the act of reading through scanning and skimming by model reading of the passages by the instructor.*	*Practice collocations*	*common errors in tenses, direct and indirect speech and syntax structure.*	*Reading of the fourth letter in the classroom and discussion* *Pizza maavu: Welcome to Mr. Mathrubootham food recipe website,*
	SLO- 2	*The recognition of different accents should be practiced by speaking after listening.*	*scanning and skimming activities*	*Idioms and phrases*	*Practicing effective writing by learning to avoid common errors in tenses, direct and indirect speech and syntax structure.*	*Mathrubootham's love for food and the miscommunication about food.*
S-9	**SLO-1**	*Learning advanced pronunciation and vocabulary through various computer applications like Woodpecker.*	*Loud reading and slow mind reading*	*A speaking task to learn- collocations, idioms and phrases, vocabulary and phonetic pronunciation*	*Teaching how to write statement of purpose for admission to higher educations, and practicing the same.*	*Analyisng the text for regional relevance and National significance.*
	SLO- 2	*imitate the different sounds and accents - repeat it after listening to any of the videos from the library based on individual interest.*	*Pauses, pronunciation, comprehension and fluency can be checked for improvement at this stage through repetitive practices.*	*Their speaking activity is to be recorded and played again to rectify the errors and highlight the problematic areas in speaking.*	*Teaching how to write a story by looking at a picture.* *Developing the writing skill through word ladders.*	*Appreciating the aesthetics of the comic element and the embodiment of humour in the narrative in the letter*
S-10	**SLO-1**	*Repeat listening to the same time frames and move from 02.01 to 03.00*	*Students -groups -checking the comprehension skills. Analyse the text of a passage.*	*Automating vocabulary through engaging the students in various activity games like solving crossword puzzle and playing scattergories.*	*Introduction to blog writing and steps to become an effective blog writer.*	*importance of bringing in the Indianized way of speaking the English Language in order to depict the character called Mathrubootham.*

	SLO- 2	*Choosing any particular time frame and practicing it.*	*Brainstorming the comprehension skills- questioning the key points in the passage.*	*Engaging the students to play the games in order to learn the vocabulary.*	*Encourage the readers to create their own blogs and post articles on a regular basis.*	*relatable characters of both formal and informal everyday life experiences.*
S 11 - S 12	**SLO-1**	Interested students can complete listening and reflecting the complete audio listening practice and speaking.	*Cross check with misunderstanding if any and rectify- match the question and answers.*	*Spur of the moment speech.:*	*Selecting any news article and learning the writing style in it.*	*Talk about their favourite letter from the letters of Mathrubootham by recollecting the appreciation of the text according to their perception and understanding.*
	SLO- 2	*Group activities and games can be conducted to test the listening skills by responding to the speech given by other students*	*Passages for reading comprehension are to be given for practice that tests their reading skills.*	*Prepared speech : Giving a speaking task to the students to speak on their own choice*	*Students are given chances to write reports on various topics.*	*Enabling the students to share their appreciation of any of their favourite lines form the books they have read.*

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*

Learning Assessment

Level	**Bloom's Level of Thinking**	**Continuous Learning Assessment (100% weightage)**			
		CLA – 1 (20%)	**CLA – 2 (20%)**	**CLA – 3 (30%)**	**CLA – 4 (30%) #**
		Practice	Practice	Practice	Practice
Level 1	Remember	10%	10%	30%	15%
	Understand				
Level 2	Apply	50%	50%	40%	50%
	Analyze				
Level 3	Evaluate	40%	40%	30%	35%
	Create				
	Total	100 %	100 %	100 %	100 %

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

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Course Code	UNS23M01L / UNC23M01L/ UNO23M01L/ UYG23M01L	Course Name	NSS/NCC/NSO/YOGA	Course Category	EA	Extension Activity/Community Outreach	L	T	P	C
							0	0	0	0

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	NSS/NCC/NSO/YOGA	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	UPY23301J	Course Name	Classical Mechanics–II	Course Category	C	*Professional Core Course*	L	T	P	O	C
							3	0	2	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:*
CLR-1 :	*Emphasize the mathematical formulation of mechanics problems*
CLR-2 :	*Understand, explain and derive the various mechanics problems*
CLR-3 :	*Comprehend about the Hamilton's principle and canonical transformation and its significance*
CLR-4 :	*Undesrstand background of small oscillations to employ in molecular system*
CLR-5 :	*Develop basic understanding of special relativity*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	*Grasp concepts of multi particle system, generalised coordinate*	*2*	*75*	*60*	H	H	-	-	-	M	-	-	-	-	-	-	-	-	-
CLO-2 :	*Learn the reference frames – equations of motion in simple force fields*	*2*	*80*	*70*	H	H	-	-	-	H	-	-	-	-	-	-	-	-	-
CLO-3 :	*Apply the concept of anonical transformation and its significance*	*2*	*70*	*65*	H	H	-	-	-	H	-	-	-	-	-	-	-	-	-
CLO-4 :	*Develop problem solving about small oscillation*	*2*	*70*	*70*	H	H	-	-	-	M	-	-	-	-	-	-	-	-	-
CLO-5 :	*Learn the basic aspects of relativity*	*2*	*80*	*70*	H	M	-	-	-	M	-	-	-	-	-	-	-	-	-

Duration (hour)		15	15	15	15	15
S-1	SLO-1	*Basics of Newtonian mechanics-reference frames, velocity, second law*	*Definition of Hamiltonian*	*Rigid body system*	*Periodic motion and types of equilibrium*	*Introduction to four-vectors*
	SLO-2	*Newtonian mechanics-equation of motion for single particle, System of particles*	*Variational principle*	*Degrees of freedom of a rigid body*	*Understanding potential energy and total energy with equilibrium state*	*position-time, energy-momentum four-vectors*
S-2	SLO-1	*Constraints with examples*	*Hamiltonian formalism, Legendre's dual transformation*	*Frames of reference of a rigid body,*	*Study of small oscillations using generalised coordinates*	*Minkowski space and Lorentz transformation in four vectors*
	SLO-2	*Classification of constraints*	*Hamilton's equations of motion from Lagrangian*	*Rotating frames*	*Phase space dynamics, Condition of stable equilibrium points*	*Deduction of Lorentz transformation*
S-3	SLO-1	*Work done*	*Basic concept of action integral*	*Body coordinate system*	*Secular equation and eigen value equation*	*Matrix notation of Lorentz transformation*
	SLO-2	*conservative force, Constraints*	*LHO equation of motion of LHO from Hamilton's equations*	*Space coordinate system*	*Solution of eigen value equation*	*Lorentz transformation in four vector form*
S-4 to S-5	SLO-1	Problems/Demos/ Simulations/Seminarss	Problems/Demos/ Simulations/Seminarss	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars
	SLO-2	.				
S-6	SLO-1	*Lagrangian Dynamics, Degrees of Freedom*	*Principle of least action and Hamilton's principle*	*Centrifugal and Coriolis forces,*	*Free vibration and Normal coordinates*	*Lorentz invariance*
	SLO-2	*Principle of virtual work*	*Simple Pendulum equation from Hamilton's equations*	*Effect of Coriolis forces*	*Normal Frequency*	*Contravariant*
S-7	SLO-1	*Lagrange's equations of first kind*	*Hamilton's equation for an ideal spring-mass arrangement*	*Euler theorem, Euler angles*	*Secular equation for normal frequency*	*Covariant*
	SLO-2	*Principle of virtual work*	*Hamiltonian function and equation of motion of different classical problem*	*Euler equations*	*Small oscillations in normal coordinates*	*Four-vector notation: velocity*
S-8	SLO-1	*D'Alembert's principle*	*Lagrangian of relativistic particles*	*Angular velocity and angular momentum of a rigid body*	*Two coupled pendulum and its characteristic equation*	*Velocity addition*
	SLO-2	*Lagrange's equations of motion, Generalized Forces, Generalised momentum, Cyclic coordinates,*	*Hamiltonian of relativistic particles*	*Inertia Tensor, Moment of Inertia matrix*	*Eigen vector of two coupled pendulum system*	*Thomas Precision Frequency*

S-9 to S-10	**SLO-1**	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2					
S-11	**SLO-1**	*Find out equation of motion of a free particle using Lagrange's equations*	*Canonical transformations*	*Product of Inertia, Principal axes*	*Vibration of triatomic chain molecules,*	*Vectors and metric tensor*
	SLO-2	*Simple Pendulum-Lagrange's equations*	*Discuss to comprehend about transformation: canonical or not*	*Kinetic energy of a rigid body*	*Potential and kinetic energy matrix of a triatomic molecule*	*Vectors and metric tensor*
S-12	**SLO-1**	*Motion under Central force, Motion under Central force-Lagrange's equations*	*Generating function for canonical transformations*	*Euler equation of motion*	*Secular equation and solution for frequencies for a triatomic molecule*	*Relativistic energy of the particles*
	SLO-2	*Lagrangian of charge particle*	*First, Second, third and fourth form of Generating function*	*Euler equation for Torque free motion*	*Discuss the eigen vector of three mode of vibration of a triatomic chain molecules*	*Energy and mass relation*
S-13	**SLO-1**	*Linear harmonic oscillator-Lagrange's equations*	*Poisson brackets and canonical transformations, Conditions for canonicality*	*Symmetric and asymmetric rigid body*	*Normal mode and vibration summary of a triatomic chain molecules*	*kinetic energy*
	SLO-2	*Atwood machine Lagrangian equation*	*Poisson brackets, Properties of Poisson brackets*	*Basic of force free motion of a symmetrical top*	*Small oscillation in two mass and two spring system*	*Relativistic kinetic energy*
S-14 to S-15	**SLO-1**	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars:*	*Problems/Demos/ Simulations/Seminars*
	SLO-2					

Learning Resources	1. *Classical Mechanics, Dr. J. C. Upadhyaya (Himalaya Publishing House Pvt. Ltd., 2014)* 2. *Classical Mechanics, H. Goldstein, C. Poole and J. Fafko (Pearson Education Inc., 2002)*	3. *Classical Mechanics, 3. J.R. Taylor (University Science Books, 2005)* 4. *Classical Mechanics of Particles and Rigid Bodies, K.C. Gupta (Wiley Eastern, 2006)*

Learning Assessment

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

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

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Course Code	UPY23302J	Course Name	Statistical Mechanics	Course Category	C	Professional Core Course	L	T	P	O	C
							3	0	2	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	comprehend the basic concepts of theory of probability for statistical mechanics	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	illustrate the macro and microscopic states and also statistical ensembles			
CLR-3 :	highlight the applications of statistical mechanics and basic of Maxwell-Boltzmann statistics			
CLR-4 :	explicate the -Einstein distribution, Fermi-Dirac statistics distribution and its applications			
CLR-5 :	understand the Bose-Einstein Condensation and basics of phase transition			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	understanding the various probability distributions for statistical mechanics	2	75	60	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
CLO-2 :	knowing about statistical ensembles and the connection of macro and microstates	2	80	70	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
CLO-3 :	understanding the statistical interpretation of entropy, work, energy etc, and basic of classical statistics	2	70	65	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
CLO-4 :	knowing about the failure of Maxwell-Boltzmann distribution, and the Fermi-Dirac and Bose-Einstein Distribution derivation	2	70	70	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
CLO-5 :	understanding the Bose-Einstein Condensation and about Ginzburg Landau theory of phase transition	2	80	70	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-

Duration (hour)		15	15	15	15	15
S-1	SLO-1	Basics of probability and statistics: probability distributions	Macroscopic States	Statistical Interpretation of the Basic Thermodynamic Variables	Failures of classical statistics	Photon gas
	SLO-2	Probability	Microscopic States	Statistical Interpretation of Energy and Work, and Pressure	Quantum Statistics	Radiation pressure Photon gas
S-2	SLO-1	Probability from an Ensemble	Phase Space	Statistical Interpretation of Entropy	Indistinguishable particles	Partition function of Photon gas
	SLO-2	Some Basic Rules of Probability Theory	The μ-Space, The Γ-space	Change in Entropy with the change in volume and change in Temperature	Postulates of Fermi Dirac statistics	Mean energy of the photon gas
S-3	SLO-1	Summation Rule, Joint Probability	Postulate of Equal a Priori Probabilities	Entropy in Terms of Probability	Derivation Fermi-Dirac Distribution	Mean pressure
	SLO-2	Conditional Probability, Continuous Random Variables	Ergodic Hypothesis: Mean Value Over an Ensemble and Over Time	Helmholtz Free Energy	Derivation Fermi-Dirac Distribution	Relation between mean pressure and Energy density
S-4 to 5	SLO-1	Problems/Demos/ Simulations/Seminarss	Problems/Demos/ Simulations/Seminarss	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars
	SLO-2	.				
S-6	SLO-1	Mean Value of a Discrete and Continuous Random Variables	Density Distribution in Phase Space	Ideal gas	Physical interpretation of Fermi-Dirac Distribution	Entropy of the thermal photons
	SLO-2	Variance : Dispersion	Liouville's Theorem	Partition function for Ideal gas	Fermi energy	Entropy of the thermal photons
S-7	SLO-1	Probability Distribution	Condition for Statistical Equilibrium	Mean energy and Pressure in Ideal gas	Define Fermi energy at zero kelvin at finite temperature	Einstein Derivation of Planck's Law
	SLO-2	Binominal Distribution	Statistical Ensembles	Free energy and Entropy calculation in Ideal gas	Explanation of Fermi –Dirac distribution at zero kelvin at finite temperature	Einstein Derivation of Planck's Law
S-8	SLO-1	Mean Value when Binominal Distribution	Microcanonical Ensemble	Gibb's paradox	Mean Energy of Fermions at zero kelvin	Bose-Einstein Condensation
	SLO-2	Fluctuation in Binominal Distribution	Canonical Ensemble	Gibb's paradox	Fermi gas in a metal	Bose-Einstein Condensation

S-9 to S-10	SLO-1 SLO-2	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
S-11	SLO-1	*Stirling Approximation*	*Gibb's Canonical Partition function*	*The Equipartition theorem*	*Electronic heat capacity of metal*	*Specific heat from lattice vibration*
	SLO-2	*Poisson Distribution*	*Gibb's Canonical Probability distribution*	*Mean kinetic energy of a molecule*	*Specific Heat of Metals*	*Specific heat from lattice vibration*
S-12	SLO-1	*Mean Values in the case of Poisson Distribution*	*Mean and Fluctuation in Energy in Grand Canonical Ensemble*	*Mean energy in three-dimensional harmonic oscillator*	*Introduction of Bose-Einstein statistics*	*Phase transition –Introduction*
	SLO-2	*Standard Deviation for Poisson Distribution*	*Grand Canonical Ensemble*	*Distinguishable particles*	*Postulates of Bose-Einstein statistics*	*Classification of Phase transition*
S-13	SLO-1	*Gaussian Distribution*	*Grand Canonical Partition function and Probability distribution*	*Postulates of Maxwell-Boltzmann statistics*	*Derivation Bose-Einstein statistics Distribution*	*Ginzburg Landau theory of phase transition*
	SLO-2	*Standard Deviation in the case of Gaussian Distribution*	*Fluctuation in Number of particles of a System in Grand Canonical Canonical Ensemble*	*Maxwell-Boltzmann distribution*	*Derivation Bose-Einstein statistics Distribution*	*Ginzburg Landau theory of phase transition*
S-14 to S-15	SLO-1 SLO-2	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*

Learning Resources	*1. R.K. Pathria, P.D. Beale, Statistical Mechanics, 3rd Ed., Elsevier, 2011.* *2. .BB Laud, Fundamentals of Statistical Mechanics.,New Edge International , 2009.* *3. K. Huang, Statistical Mechanics, 2nd Ed., Wiley, 2008.*	*4. L.D. Landau and E.M. Lifshitz, Statistical Physics, 3rd Ed., Pergamon Press, 1980.* *5. R.E. Sonntag, G.J. Van Wylen, Introduction to Thermodynamics, Classical and Statistical, 3rd Ed., Wiley, 1991.* *6. J.M. Seddon and D. Julian, Thermodynamics and Statistical Mechanics, 3rd Ed., RSC publication, 2001.*

Learning Assessment

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

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

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. V Subramanian, CLRI, subbu@clri.res.in	Dr. Ranjit Kumar Nanda, IIT Madras, nandab@iitm.ac.in	*Dr. Alok Kumar, SRMIST*
Dr. M Satish, CSIR-CECRI, msathish@cecri.re.in	Dr.G.Kalpana, Anna University, g_kalpa@annauniv.edu	*Dr. Bhaskar Behera, SRMIST*

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Course Code	UPY23303J	Course Name	Computational Physics	Course Category	C	*Professional Core Course*	L	T	P	O	C
							3	0	3	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	*develop basic understanding of scientific programming*
CLR-2 :	*develop skill to write algorithm of a problem and convert the algorithm to code*
CLR-3 :	*bridge the gap between the theory and computational applications*
CLR-4 :	*acquire advanced knowledge in current computational standards*
CLR-5 :	*acquire knowledge of advanced techniques like oop and parallel programming*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning 1 Level of Thinking (Bloom)	Learning 2 Expected Proficiency (%)	Learning 3 Expected Attainment (%)	PLO 1 Fundamental Knowledge	PLO 2 Application of Concepts	PLO 3 Link with Related	PLO 4 Procedural Knowledge	PLO 5 Skills in Specialization	PLO 6 Ability to Utilize	PLO 7 Skills in Modeling	PLO 8 Analyze, Interpret Data	PLO 9 Investigative Skills	PLO 10 Problem Solving Skills	PLO 11 Communication Skills	PLO 12 Analytical Skills	PLO 13 PSO -1	PLO 14 PSO -2	PLO 15 PSO-3
CLO-1 :	*write and execute fortran code*	2	80	75	H	H	-	-	-	-	H	-	-	-	-	H	-	-	-
CLO-2 :	*solve linear algebra problems using subprograms*	2	80	70	H	H	-	-	-	-	H	-	-	-	-	H	-	-	-
CLO-3 :	*plotting existing data with fortran and random numbers*	2	75	70	H	H	-	-	-	-	H	-	-	-	-	H	-	-	-
CLO-4 :	*programming and solving problems learned in other topics*	2	80	75	H	H	-	-	-	-	H	-	-	-	-	H	-	-	-
CLO-5 :	*solving real life problems numerically*	2	80	70	H	H	-	-	-	-	H	-	-	-	-	H	-	-	-

Duration (hour)		18	18	18	18	18
S-1	SLO-1	*Introduction to computer, language and Fortran*	*User defined functions and subroutines*	*Allocatable array: idea of dynamic memory allocation*	*Basics of object oriented programming*	*Numerical derivatives*
	SLO-2	*Binary numbers, Two's complement*	*User defined functions and subroutines*	*Allocatable array*	*Class, Fields and Methods*	*Numerical derivatives*
S-2	SLO-1	*Structure of a program; Fortran Hello World*	*User defined functions and subroutines*	*pointers and target: memory reference*	*Class, Fields and Methods*	*Numerical derivatives*
	SLO-2	*Compilers, basic compiler options*	*User defined functions and subroutines*	*pointers and target and association*	*Class, Fields and Methods*	*Numerical derivatives*
S-3	SLO-1	*Constants and variable data type, User defined data type;*	*Modules*	*Random number*	*Root Finding: Bisection Method*	*Numerical Integration: Basis*
	SLO-2	*Assignment and basic arithmetic; intrinsic functions and subroutines*	*Modules*	*Random number generator (LCG)*	*Root Finding: Bisection Method*	*Trapezoidal Rule*
S-4 to S-6	SLO-1	*Lab 1. Writing basic arithmetic operatiions code*	*Lab 3: Calculate the area of geometric objects using subprograms*	*Lab 5: Solve equations of motions.*	*Lab 7: Student's information as OOP*	*Lab 9: Numerical derivative and Integration using Trapezoidal Rule*
	SLO-2					
S-7	SLO-1	*Basic IO concept*	*sharing data between procedures*	*Random number generator (LCG)*	*Quick Sort algorithm*	*Simpson's 1/3 Rule*
	SLO-2	*Format specifications*	*sharing data between procedure, INTENT Statement*	*Random number generator (LCG)*	*Quick Sort algorithm*	*Simpson's 1/3 Rule*
S-8	SLO-1	*Logical constants, variables and operators*	*Stream Access, Direct access*	*Monte Carlo Method*	*Heap Sort algorithm*	*Simpson's 1/3 Rule*
	SLO-2	*Branching, assignments and relation calculator*	*Arrays in fortran, array operations*	*Monte Carlo Method*	*Heap Sort algorithm*	*Simpson's 1/3 Rule*
S-9	SLO-1	*Do loop, While loop, Do while loop,*	*Whole array operation*	*Monte Carlo Method*	*Cramer's Rule*	*Ordinary differential Equation*
	SLO-2	*Do loop, While loop, Do while loop,*	*Whole array operation*	*Monte Carlo Method*	*Cramer's Rule*	*RK4 method*
S-10 to S-12	SLO-1	*Lab 2: Fibonacci series without array; Factorial calculation*	*Lab 4: Fibonacci Series with array*	*Lab 6: Calculation of π using Monte Carlo method*	*Lab 8: Quick sort code*	*Lab 10: Newton Raphson method*
	SLO-2					
S-13	SLO-1	*Cycle and exit statement*	*Matrix operations with fortran*	*Plotting using command line*	*Cramer's Rule*	*RK4 method*
	SLO-2	*If construct, If-else-if construct, Case construct*	*Matrix operations with fortran*	*gnuplot*	*Jacobi Iteration*	*RK4 method*

S-14	**SLO-1**	*If construct, If-else-if construct, Case construct*	*Matrix operations with fortran using LAPACK*	*Application and data analysis with gnuplot*	*Jacobi Iteration*	*RK4 method*
	SLO-2	*If construct, If-else-if construct, Case construct*	*Matrix operations with fortran using LAPACK*	*Application and data analysis with gnuplot*	*Jacobi Iteration*	*RK4 method*
S-15	**SLO-1**	*Error, round off error,Error analysis*	*Interpolation/Extrapolation*	*Examples: Bifurcation Method*	*Introduction to parallel programming using OpenMP*	*Discussions and doubt clearing*
	SLO-2	*Error, round off error,Error analysis*	*Interpolation/Extrapolation*	*Examples: Bifurcation Method*	*Introduction to parallel programming using OpenMP*	
S-16 to S-18	**SLO-1**	*Discussions and doubt clearing*	*Discussions and doubt clearing*	*Discussions and doubt clearing*	*Discussions and doubt clearing*	*Discussions and doubt clearing*
	SLO-2					

Learning Resources	1. Michael Metcalf, John Reid, and Malcolm Cohen, Modern Fortran Explained:Incorporating Fortran 2018, OUP Oxford; 5th edition, 2018 2. W.S. Brainerd , Guide to fortran 2008 Programming, Springer, 2nd ed. 2015	3. Subrata Roy, Fortran 2018 with Parallel Programming,Chapman and Hall/CRC; 1st edition, 2019 4. W. Press et.al., Numerical Recipes 3rd Edition: The Art of Scientific Computing, Cambridge University Press; 3rd edition, 2007

Learning Assessment

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

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

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
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Dr. Ajay Singh, BARC, Mumbai, ajay@barc.gov.in	Prof. Subhradip Ghosh, IIT Guwahati, subhra@iitg.ac.in	*Dr. Rohit Dhir, SRMIST*

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

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

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

		1	2	3
CLR-1 :	தமிழின் எழுத்து, சொல் வளர்ச்சி வரலாற்றை அறியச் செய்தல்	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	மொழியைப் பிழையின்றி எழுதும் ஆற்றலை அடையச் செய்தல்			
CLR-3 :	வாய்மொழி வழக்காறுகளின் நுட்பங்களைத் தெரியச் செய்தல்			
CLR-4 :	கடிதம் எழுதும் முறை, கட்டுரை வரையும் முறை அறியச் செய்தல்			
CLR-5 :	படைப்பாற்றல் திறனை வளரச் செய்தல்			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	சொற்களைச் சரியான பொருண்மையில் பயன்படுத்தும் திறன் பெறுதல்	2	75	60	H	L	H	M	H	H	L	M	H	M	L	H	-	-	-
CLO-2 :	மொழியைப் பிழையின்றி எழுதுவதன் வழி மொழி ஆளுமை பெறுதல்	2	80	70	H	M	H	L	M	H	L	H	M	L	H	H	-	-	-
CLO-3 :	வாய்மொழி மரபின் கூறுகள் வழி, மக்களின் வாழ்வியல் விழுமியங்களை அறிந்துகொள்ளுதல்	2	70	65	H	L	H	M	H	H	M	H	L	H	M	H	-	-	-
CLO-4 :	அலுவலகப் பயன்பாடு, திறன் மேம்பாடு ஆகியவற்றை நுட்பமாகத் தெரிந்துகொள்ளுதல்	2	70	70	H	M	H	L	H	M	M	H	H	L	H	H	-	-	-
CLO-5 :	கவிதை, கதை படைக்கும் ஆற்றலை அறிந்துகொள்ளுதல்	2	80	70	H	M	H	H	M	H	L	M	H	L	H	H	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	தமிழின் தொன்மை	மெய்யெழுத்துகளின் வகைகள்	வாய்மொழி மரபு, எழுத்து மரபு	தொடர் அமைப்பு	காலந்தோறும் கவிதை
	SLO-2	தமிழின் சிறப்புகள்	மூவினம்	வாய்மொழி மரபில் அனுபவம்	எளிய தொடர்	கவிதை வடிவம்
S-2	SLO-1	கருத்து – பரிமாற்றம்	ஒற்று இடுதல்	வாழ்வியல் தத்துவம்	நெடுந்தொடர்	மரபுக்கவிதை
	SLO-2	பயன்பாட்டுத்தமிழ்	வல்லினம் மிகும் இடங்கள்	பழமொழிகள்	பத்தி எழுதுதல்	வசனகவிதை
S-3	SLO-1	காலந்தோறும் தமிழ்	வல்லினம் மிகா இடங்கள்	பழமொழியும் மனித வாழ்வியலும்	ஒரு பொருளை மையமாகக் கொண்டு எழுதுதல்	புதுக்கவிதை/ புதிய வடிவக் கவிதைகள்
	SLO-2	எழுத்துகள் - அறிமுகம்	எழுத்துப்பிழை நீக்கம்	பழமொழியின் வடிவம்	காலந்தோறும் கடிதங்கள்	கவிதைக் களங்கள்
S-4	SLO-1	தமிழ் எழுத்து வரலாறு	பிழை நீக்கி எழுதுதலின் அவசியம்	வட்டார மொழி	தமிழில் கடித இலக்கியம்	கவிதை உள்ளடக்கம்
	SLO-2	எழுத்துகளின் வரிவடிவம்	பிழைகளும் மொழிச் சிக்கல்களும்	வட்டார மொழியில் சொலவடை	கடித வகைகள்	கவிதை எழுதும் முறை
S-5	SLO-1	எழுத்துகளின் பிறப்பு	எதிர்ச்சொல் வரலாறு	பழமொழியும் சொலவடையும்	கடிதம் எழுதும்முறை	தன்னுணர்ச்சிக் கவிதை
	SLO-2	உயிர் எழுத்துப் பிறப்பு	எதிர்ச்சொல்லின் உருவாக்கம்	பேச்சுநடையும் சொலவடையும்	அலுவல் கடிதம்	இயற்கை/ சமூகம் - கவிதை
S-6	SLO-1	மெய்யெழுத்துப் பிறப்பு	இணைச்சொல்லும் எதிர்ச்சொல்லும்	மரபுத்தொடர்	வாழ்த்து/ பாராட்டுக் / நட்புக் கடிதம்	காலந்தோறும் கதைகள்

	SLO-2	மொழி முதல் எழுத்துகள்	தமிழில் எதிர்ச்சொற்கள்	பழமொழி மரபுத் தொடர் வேறுபாடு	கட்டுரை வகைகள்	கதைகளில் கற்பனையும் உண்மையும்
S-7	SLO-1	மொழி இறுதி எழுத்துகள்	ஓரெழுத்து ஒருமொழி – அறிமுகம்	தமிழில் மரபுத்தொடர்	கட்டுரை எழுதும் முறை	வாய்மொழிக் கதை
	SLO-2	எழுத்து வேறுபாடும் பொருளும்	ஓரெழுத்து ஒருமொழியும் பொருளும்	விடுகதை	கட்டுரைக் களங்கள்	ஒரு பக்கக் கதை
S-8	SLO-1	ணகர - னகர - நகர வேறுபாடு	சொற்களின் தன்மைகள்	நுண்ணறிவு வெளிப்படுதல்	போட்டிக் கட்டுரை	சிறுகதை
	SLO-2	லகர – ளகர - ழகர வேறுபாடு	ஒரு சொல் பல பொருள்	கதை மரபில் நாட்டுப்புறக் கதைகள்	அனுபவக் கட்டுரை	கதை எழுதும் முறை
S-9	SLO-1	சொல்லும் பொருளும்	ஒரு பொருள் பல சொல்	தமிழில் நாட்டுப்புறக் கதைகள்	பயணக் கட்டுரை	சமூக உணர்வின் வெளிப்பாடு
	SLO-2	காலந்தோறும் சொற்கள்	சொல் உருவாக்கத்தின் பயன்கள்	நாட்டுப்புறக் கதைகளும் சமூக வரலாறும்	இதழியல் கட்டுரைகள்	நிகழ்வைக் கதை வழியே வெளியிடல்

Learning Resources	1. நல்ல தமிழ் எழுத வேண்டுமா?, அ. கி. பரந்தாமனார், பாரி நிலையம், 2010. 2. நாட்டுப்புற இயல் ஆய்வு, சு. சக்திவேல், மணிவாசகர் பதிப்பகம், சென்னை, 2006. 3. படைப்புக்கலை, மு. சுதந்திரமுத்து, அறிவுப் பதிப்பகம், சென்னை, 2008. 4. கதையியல், க. பூரணச்சந்திரன், அடையாளம் பதிப்பகம், சென்னை, 2012. 5. இணைய வழித் தரவுகள் : https://tamilheritage.org/

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

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

Course Designers		
Experts from Industry	**Expert from Higher Technical Institutions**	**Internal Experts**
1. Dr. P.R.Subramanian, Director, Mozhi Trust, Thiruvanmiyur, Chennai – 600 041.	*1. Dr. V. Dhanalakshmi, Associate Professor, Subramania Bharathi School of Tamil Language & Literaturel, Pondicherry University, Pondicherry*	*1. Dr. B.Jaiganesh, Associate Professor & Head, Dept. of Tamil, FSH, SRMIST,KTR*
		2. Dr. R. Ravi, Assistant Professor and Head, Dept. of Tamil, FSH, SRMIST, VDP.
		3. Mr. G. Ganesh, Assistant Professor, Dept. of Tamil, FSH, SRMIST, RMP.
		4. Dr. T.R.Hebzibah beulah Suganthi, Assistant Professor, Dept. of Tamil, FSH, SRMIST, KTR.
		5. Dr. S.Saraswathy, Assistant Professor, Dept. of Tamil, FSH, SRMIST, KTR.

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

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

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

		1	2	3
CLR-1 :	Explain and appreciate the Constant moral values of India			
CLR-2 :	Focus on Evaluating the social changes through prose			
CLR-3 :	To Display moral and social values in the field of religion and communal Unity			
CLR-4 :	To make translation of good literature and any relevant document from the Hindi Language to English and vice –versa			
CLR-5 :	To help the learners to tackle Administrative terminology			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	**Understand the various forms of Prose and different aspects of social issues**	2	75	80	H	H	H	M	L	H	L	M	L	L	H	M	-	-	-
CLO-2 :	**To create an awerness on Ramayanan**	2	80	90	H	H	H	M	L	H	H	M	L	L	H	M	-	-	-
CLO-3 :	**To Examine the accuracy in Translation**	2	75	95	H	H	M	L	H	H	M	H	M	M	H	H	-	-	-
CLO-4 :	To Provide technical writing skills	2	80	90	H	H	L	H	M	H	L	H	H	M	H	H	-	-	-
CLO-5 :	**To evaluate the nuance in essays**	2	85	90	M	H	M	H	L	H	H	L	H	M	H	H	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	KAHANI	NIBANDH	BAL RAMAYAN	ANUVAD	PARIBHASHIK SHABDAVALI
	SLO-2	AVDHARNA	VDHARNA	KHATHA VASHTU	AVDHARNA	ARTH
S-2	SLO-1	ARTH	ARTH	AVADHPURI MEN RAM	ARTH	PARIBHASHA
	SLO-2	SWARUP	SWARUP	RAM KE ADARSH KE PRATI PRERIT KARNA	SWARUP	SWARUP
S-3	SLO-1	PARIBHASHA	PARIBHASHA	RAMAYAN KE PRATI RUCHI JAGANA	PARIBHASHA	PRAKAR
	SLO-2	KAHANI KE TATVA	MAHABHARAT KE SAMAY KA BHARAT-BHALKRISHNA BHATT	RAMAYAN KA SAMAJ MEN MAHATVA	PRAKAR	AVADHARNA
S-4	SLO-1	UDDESHYA	LEKHAK PARICHAYA	LOKJEEVAN KE PRATI JAGRUP KARNA	MAHATVA	PRAYOJAN
	SLO-2		PATH KA VISLESHAN	JANGAL AUR JANKPUR	UDDESHYA	UDDESHYA
S-5	SLO-1	ANTASH MAN KI JAGRITI	UDDESHYA	GURU KE PRATI ADAR BHAV	ANUBAD PRAKRIYA	MAHATVA
	SLO-2	EIDGAH – KAHANI PREMCHAND	SAMAJIK SAMRASTA	VIRTA KE BHAV KO JAGANA	VIVIDH PRAYOG	PRAYOG
S-6	SLO-1	KAHANI KA PARICHAYA	PAURANIK KAHANIYO SE AVAGAT KARANA	VIDHARM KA PRATIFAL	HINDI SE ANGREZI ANUVAD	UDDESHYA
	SLO-2	KAHANI VISLESHAN	MAHABHARAT EVAM RAMAYAN KE SAMAJ KI TULNA	VAN JEVAN SE AVAGAT KARANA	ANGREZI SE HINDI ANUVAD	TAKANIKI SHABDAVALI KA MHATVA
S-7	SLO-1	BAL MANOVIGYAN	BABUL AUR KAKTASH-RAMDARASH MISHRA	SITA KE ADARSH CHARITRA SE AVAGAT KARANA	ANUVAD KA PRAYOJAN	HINDI SE ANGREZI SHABD
	SLO-2	ASMANTA KA CHITRAN	LEKHAK PARICHAY	RAM KE CHARITRA SE AVAGAT KARANA	ANUVAD KA PRAYOG	ANGREZI SE HINDI SHABD
S-8	SLO-1	DIP SE DIP JALE- USHA YADAV	PATH KA VISLESHAN	VIRTA KE BHAV JAGANA	SHROT BHASHA KA GYAN	EK DIN EK SHABD
	SLO-2	SAPNE KE LIYE SANGHARSH	MANVATA KO JIVIT RAKHANE KI PRERNA	PATH KA VISLESHAN	LAKSHYA BHASHA KA GYAN	SHABDON KA VISLESHAN

S-9	*SLO-1*	*SAMASYA KA SMADHAN JAD MEN HOTA HAI*	*AAJ KE SANDARBH ME MAHABHARAT KI UPYOGITA*	*PATH PRICHARCHA*	*ANUVAD KA DAYITVA*	*PATH PRICHARCHA*
	SLO-2	*PRASHNABHAYASH*	*PRASHNABHAYASH*	*PRASHNABHAYASH*	*ANUVAD KA ABHYASH*	*PRASHNABHAYASH*

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

Learning Assessment

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

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

Course Designers

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

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

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

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

		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Strengthen the language of the students both in oral and written			
CLR-2 :	Express their sentiments, emotions and opinions, reacting to information, situations			
CLR-3 :	Make them learn the basic rules of French Grammar.			
CLR-4 :	Develop strategies of comprehension of texts of different origin			
CLR-5 :	Enable the students to overcome the fear of speaking a foreign language and take position as a foreigner speaking French			

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

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

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

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

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

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

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

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

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

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning Level of Thinking (Bloom)	PLO 1 Fundamental Knowledge	PLO 2 Application of Concepts	PLO 3 Link with Related Disciplines	PLO 4 Procedural Knowledge	PLO 5 Skills in Specialization	PLO 6 Ability to Utilize Knowledge	PLO 7 Skills in Modeling	PLO 8 Analyze, Interpret Data	PLO 9 Investigative Skills	PLO 10 Problem Solving Skills	PLO 11 Communication Skills	PLO 12 Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	Gain knowledge on the basics in organic chemistry.	4	H	-	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-2 :	Promote the importance of silicon and metals.	4	-	-	-	-	H	-	H	-	-	-	-	-	-	-	-
CLO-3 :	Understand the facts in chemical kinetics	4	-	-	-	-	M	-	H	-	-	-	-	-	-	-	-
CLO-4 :	Acquire knowledge in the principles of electrochemistry	4	-	-	-	H	-	-	H	-	-	-	-	-	-	-	-
CLO-5 :	Understand the basic concepts in industrial chemistry	4	-		H	-	-	H	-	-	-	-	-	-	-	-	-

Duration (hour)		18	18	18	18	18
S-1	SLO-1	Introduction of Hybridisation and Isomerism: Hybridisation - sp, sp^2	Addition reactions:	Coordination Chemistry: Nomenclature	Electrochemistry: Introduction	soaps. - structure and cleansing action
	SLO-2	sp^3 Hybridisation	Nucleophilic Addition reactions:	isomerism of coordination compounds	Faradays laws of electrolysis	Soap-examples
S-2	SLO-1	Bond length- bond angle- dipole moment	Electrophilic Addition reactions:	EAN rule	Specific conductance, equivalent conductance	Detergents - structure and cleansing action
	SLO-2	inductive effect- mesomeric effect and hyperconjucation	Free radical Addition reactions	VB Theory	Cell constant	Detergent - examples
S-3	SLO-1	Isomerism- geometrical and optical isomerism	Elimination rections	Crystal field theories of octahedral complexes	Arrhenius theory of electrolytic dissociation	Industrial Chemistry: Introduction-Fuel gas
	SLO-2	Structural isomers and stereoisomers	E1, E2, E1cb mechanism	tetrahedral and square planar complexes	Arrhenius theory of electrolytic dissociation-explanation	Water gas
S-4-6	SLO-1	Lab Introduction	Estimation of ascorbic acid	Estimation of $KMnO_4$using standard potassium dichromate	Determination of strength of an acid – Conductometric titration	Estimation of Nickel using decinormal solution of EDTA
	SLO-2					
S-7	SLO-1	Configurations, chirality	Chemistry of Hydrogen	Chemical Kinetics: Rate of reaction	Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes.	producer gas
	SLO-2	Elements of symmetry	Isotopes of hydrogen	order- molecularity	Molar conductivity at infinite dilution	LPG gas
S-8	SLO-1	Enantiomers	Occurrence- extraction of iron	first order rate law and simple problems	Ostwald"s dilution law	Gobar gas and
	SLO-2	diastereomers	Occurrence- extraction of cobalt	Half-life period of first order reaction	Activity- Ostwald"s dilution law	natural gas
S-9	SLO-1	Conformational analysis - ethane	Occurrence- extraction of nickel	pseudo first order reaction	Kohlrausch law of independent migration of ions	Fertilizers – Mixed fertilizer
	SLO-2	Conformational analysis – n-butane	Occurrence- extraction of copper	zero and second order reactions	Problems - Kohlrausch law of independent migration of ions	NPK fertilizer

Duration (hour)		18	18	18	18	18
S-10-12	SLO-1	Estimation of HCl using standard oxalic acid	Estimation of Copper using decinormal solution of Potassium dichromate solution	Determination of rate of the reaction – Ester hydrolysis	Determination of strength of mixture of acids – Conductometric titration	Estimation of $K_2Cr_2O_7$ using decinormal solution of Sodium thiosulphate solution
	SLO-2					
S-13	SLO-1	Nucleophilic substitution reactions	structure of borazole	Arrhenius theory-Postulates	Nernst equation -Derivation	Hardness of water – Temporary and permanent hardness
	SLO-2	SN1 mechanism	Preparation of borazole	Explanation and limitation	Problems – Nernst equation	disadvantages of hard water
S-14	SLO-1	SN2 mechanism	Chemistry of Silicon compounds	Collision theories-Postulates	Nernst equation applications	Boiler scales and sludges
	SLO-2	Free radical mechanism	Structure and Preparation of SiO_2	Explanation and limitation	Nernst equation application to different kinds of half-cells	Softening of hard water – Zeolite process
S-15	SLO-1	Electrophilic substitution reactions	Structure and Preparation of SiC	Problems/activities related to kinetics	Kohlrausch law of independent migration of ions	demineralization process - Principle
	SLO-2	Mechanism	Structure and Preparation of $SiCl_4$	Problems/activities related to kinetics	Ostwald"s dilution law	demineralization process -Procedure
S-16-18	SLO-1	Estimation of phenol / aniline	Estimation of NaOH using standard sodium carbonate	Estimation of FAS using standard oxalic acid	Redox titration by Potentiometric method	Estimation of hardness by EDTA method
	SLO-2					

Learning Resources	Theory:

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

Learning Assessment

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

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

Course Designers

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

Course Code	UPY23G02T	Course Name	Laser Physics	Course Category	G	Generic elective course	L	T	P	O	C
							3	1	0	2	4

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

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

Duration (hour)		12	12	12	12	12
S-1	SLO-1	General Introduction to lasers	Cavity life time and Quality factor	Geometrical optics analysis of optical resonators	Introduction to Q-switching	Coherence properties of laser light
	SLO-2	Spontaneous and stimulated emission Stimulated absorption	Ultimate line width of a laser	Condition for stable resonators	Dynamics of the Q-switching process	Temporal coherence
S-2	SLO-1	The laser idea	Einstein's A and B Coefficients	Stability diagram for optical resonators	Electro-optical Q-switching	Spatial coherence
	SLO-2	Gain medium, pumping scheme and optical feedback	Ratio of A and B at thermal equilibrium	Sources of resonator loss	Introduction to mode locking	Young's double slit experiment to understand spatial coherence
S-3	SLO-1	Properties of laser beams: Monochromaticity	Introduction to resonators	Laser rate equations	Mathematical interpretation for mode locking	Specific laser systems
	SLO-2	Directionality, coherence	Fabry-Perot cavity	Introduction to four level laser system	Mathematical interpretation for mode locking	Ruby laser
S-4	SLO-1	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars
	SLO-2	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars
S-5	SLO-1	Modes of a cavity	Basic apparatus	Mathematical formulation of rate equations for four level laser system	Passive mode locking	He:Ne laser
	SLO-2	Black body radiation	Elementary theory of Fabry-Perot cavity	Mathematical formulation of rate equations for four level laser system	Active mode locking	Carbon dioxide laser
S-6	SLO-1	Black body radiation	Transmission spectrum of a Fabry-Perot cavity	Condition for population inversion	Concept of Gain saturation	Dye lasers, semiconductor lasers
	SLO-2	Calculation of mode density for black body	Coefficient of finesse/Quality factor	Threshold condition for four level system	Hole burning	DBR lasers
S-7	SLO-1	Calculating number of photons per mode for black body	Fundamental Gaussian beam	Calculating threshold for He-Ne laser	Spatial hole burning	Nd:YAG laser
	SLO-2	Comparison of black body radiation with laser radiation	Gaussian beam in homogeneous medium	Integrating cavity rate equation	Longitudinal and transverse mode selection	Higher harmonic generation

S-8	**SLO-1**	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
S-9	**SLO-1**	*Line shape functions*	*Gaussian beam focusing*	*Rate equations under steady state condition*	*Single mode operation*	*Physics of harmonic generation*
	SLO-2	*Line-broadening mechanisms*	*Gaussian beam focusing*	*Rate equations under steady state condition*	*Multi-mode lasers*	*Physics of harmonic generation*
S-10	**SLO-1**	*Homogeneous broadening*	*Higher order Hermite Gauss beams*	*Variation of laser power around the threshold*	*Gain competition*	*Second harmonic generation*
	SLO-2	*Inhomogeneous broadening*	*Higher order Hermite Gauss beams*	*Variation of laser power around the threshold*	*Gain competition*	*Third harmonic generation*
S-11	**SLO-1**	*Natural, Doppler and Collison broadening*	*Analysis of higher order Hermite Gauss beams*	*Optimum output coupling*	*Optical amplifiers*	*Classification of lasers*
	SLO-2	*Natural, Doppler and Collison broadening*	*Analysis of higher order Hermite Gauss beams*	*Laser spiking*	*Optical amplifiers*	*Laser safety*
S-12	**SLO-1**	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*

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

Learning Assessment

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

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

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

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Course Code	UPY23S01L	Course Name	Workshop Practice	Course Category	S	Skill Enhancement Course	L	T	P	O	C
							0	0	2	2	1

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 :	*use mechanical tools to make simple measurement of length, height, time, areaand volume.*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO - 1	PSO - 2	PSO - 3
CLR-2 :	*obtain hand on experience for casting and foundry*																		
CLR-3 :	*obtain hand on experience of workshop practice by doing machining and welding*																		
CLR-4 :	*learn to us e various machine tool like lathe shaper, milling and drilling machines etc.*																		
CLR-5 :	*acquire skills in working with wooden and metal blocks*																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1 :	*familiarize with the basics of tools and equipment used in fitting, carpentry, sheet metal, welding and smithy*	2	80	75	-	-	-	*H*	*H*	*H*	-	-	-	-	-	-	-	-	-
CLO-2 :	*familiarize with the production of simple models in the above trades*	2	80	70	-	-	-	*H*	*H*	*H*	-	-	-	-	-	-	-	-	-
CLO-3 :	*have hands on experience of the instruments in workshop*	2	75	70	-	-	-	*H*	*H*	*H*	-	-	-	-	-	-	-	-	-
CLO-4 :	*understand the principle behind the working of various equipment*	2	80	75	-	-	-	*H*	*H*	*H*	-	-	-	-	-	-	-	-	-
CLO-5 :	*acquire mechanical skills in the basic workshops*	2	80	70	-	-	-	*H*	*H*	*H*	-	-	-	-	-	-	-	-	-

DURATION (HOURS)		6	6	6	6	6
S-1 to S-2	SLO-1	*Basics of Experiments*	*Simple turning of cylindrical surface on MS rod using lathe machine tool.*	*Lap joint of two metal plates overlapping on one another using arc welding process.*	*Cross halving joint of two wooden pieces at perpendicular direction.*	*To make duster from wooden piece using carpentry tools.*
	SLO-2					
S-3to S-4	SLO-1	*Step fitting of two metal plates using fitting tools.*	*Plumbing of bathroom/kitchen fitting using various plumbing components and tools*	*T–joint of a metal plate at perpendicular direction over another plate using arc welding process.*	*Dovetail halving joint of two wooden pieces in the shape of dovetail.*	*To make rectangular shaped tray using GI sheet.*
	SLO-2					
S-5 to S-6	SLO-1	*Drilling & Tapping for generating hole and internal thread on a metal plate.*	*Butt joint of two metal plates using arc welding process.*	*MIG welding of metal plates.*	*To make circular shapes, grooving in wood piece using wood turning lathe.*	*To make geometrical shape like frustum, cone and prisms using GI sheet.*
	SLO-2					

Learning Resources	1. Manual on Workshop Practice, Kannaiah.P and Narayanan.K.C, (Scitech Publications, 1999) 2. A first course on workshop practice, Theory, Practice and Work Book, Gopal T.V, Kumar.T, and Murali (G Suma Publications, Chennai, 2005). 3. Shop Theory, James Anderson and Tatro. E, (Tata McGraw Hill Publishing Company, 2006) 4. Machine Shop Basics, Rex Miller and Mark Richard Miller, (5th Edition, Audel Publishing company, 2005) 5. Workshop Technology, Chapman,W.A.J, (5th Edition, Routledge Company, 2016)

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

CLA – 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. N Palani, RANE TRW Steering Systems, n.palani@ranegroup.com	Dr. GB Bhaskaran, MIT Chrompet, drgbhaskar@mitindia.edu	Dr. B. Gunasekaran, SRMIST
Mr. SV Shanmugam, Hyundai Motor India Ltd, vigneshshanmugam1791@gmail.com	Dr. Muruganandhan, Anna University, muruganandhan@annauniv.edu	Dr. T. Rajasekar, SRMIST

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Course Code	UPY23P01L	Course Name	Internship - I	Course Category	P	Internship/ Project	L	T	P	O	C
							0	0	0	0	1

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:
CLR-1:	*assist the student's professional skill development useful to employer such as teamwork, communications and work ethics & details*
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:
CLO-1:	*demonstrate the skill gained through work experience with mentors or successful professionals to support the early stages of their career*

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

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Course Code	UCD23V02T	Course Name	Industry Oriented Employability Skills for Science	Course Category	V	Value Addition course	L	T	P	O	C
							2	0	0	2	2

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Demonstrate various principles involved in solving mathematical concepts related to permutation and combination and probability and interpret data
CLR-2 :	Learn the basic mechanics of grammar and develop resume-building practice and presentation skills in students
CLR-3 :	Understand the object oriented features
CLR-4 :	Prepare students for job interviews
CLR-5 :	Instill confidence in students and develop the necessary skills to face interview

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	ICT Skills	Professional Behaviour	Life Long Learning
CLO-1 :	Understand the concepts of permutation and combinations, probability and approach questions in a simpler and innovative method	3	80	70	M	M	-	M	-	H	-	M	H	M	-	H	-	-	-
CLO-2 :	Understand the different parts of speech and use them in sentences appropriately and also the importance of resume preparation	3	85	75	M	-	-	M	-	H	-	-	-	-	H	-	-	L	H
CLO-3 :	Understand the importance of object oriented features	3	85	80	H	M	M	M	M	H	L	-	-	-	-	-	M	-	H
CLO-4 :	Face interviews confidently	3	85	80	M	M	H	M	M	H	L	-	-	-	-	-	M	-	H
CLO-5 :	Develop their domain skills to face the interview	3	85	80	M	M	H	M	M	H	L	-	-	-	-	-	M	-	H

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

Learning Resources	1. *Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Tata McGraw Hill, 5th Edition* 2. *Scott Bennett, The Elements of Resume Style: Essential Rules for Writing Resumes and Cover Letters That Work, AMACOM, 2014* 3. *Raymond Murphy, Intermediate English Grammar, Cambridge University Press, 2007*	4. *Greg Perry, Dean Miller, C Programming Absolute Beginne, Que Publishing, 3rd Edition* 5. *Cay S. Horstmann, Core Java Fundamentals, Volume 1, 11th Edition, Prentice Hall, 2018* 6. *Langsam, Augenstein, Tanenbaum, Data Structures Using C and C++, 2nd Edition, Pearson Education, 2015.*

Learning Assessment

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

CLA-1, CLA-2 and CLA-3 can be from any combination of these: Online Aptitude Tests, Classroom Activities, Case Studies, Poster Presentations, Power-point Presentations, Mini Talks, Group Discussions, Mock interviews, etc.

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

Course Designers

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

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SEMESTER IV

Course Code	UPY23401J	Course Name	Quantum Mechanics I	Course Category	C	Professional core course	L	T	P	O	C
							3	0	2	2	4

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*understand the inadequacy of classical physics and the need for quantum theory*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*familiarize with quantum mechanical observables and their operator form*			
CLR-3 :	*solve 1D potentials using the Schrodinger equation*			
CLR-4 :	*apply quantum mechanics to atomic systems*			
CLR-5 :	*apply the theory of angular momentum to spin*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	*understand the need of quantum mechanics and the concept of wave particle duality*	2	75	60	H	H	H	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*learn the fundamental postulates of non-relativistic quantum mechanics*	2	80	70	H	-	H		-	H	-	-	-	-	-	-	-	-	-
CLO-3 :	*apply the Schrodinger equation to fully-solvable problems in 1D*	2	70	65	-	H	-	-	-	-	-	H	-	H	-	-	-	-	-
CLO-4 :	*apply the Schrodinger equation to single-electron systems*	2	70	70	-	H	-	-	-	-	-	H	-	H	-	-	-	-	-
CLO-5 :	*study the theory of spin angular momentum*	2	80	70	H	H	-	-	-	-	H	-	-	-	-	-	-	-	-

Duration (hour)		15	15	15	15	15
S-1	SLO-1	*Inadequacy of classical mechanics (CM) and the need of quantum mechanics*	*Time-dependent Schrodinger's equation*	*Introduction to finite potential well and step potentials in 1D*	*Schrodinger's equation in 3D: introduction to the Hydrogen atom problem in quantum mechanics*	*Magnetic moment of an electron due to spin*
	SLO-2	*Blackbody radiation: Rayleigh-Jeans vs Planck's law*	*Time-independent Schrodinger's equation*	*Finite potential well (1D)*	*Schrodinger's equation in spherical polar co-ordinates*	*Stern-Gerlach experiment and Interpretation of the results*
S-2	SLO-1	*Concept of quanta and quantum theory of light*	*Time evolution of the wave function*	*Energy eigenvalues of a particle in a finite square well potential (1D)*	*Method of separation of variables: separation of radial and angular equations*	*Space quantization*
	SLO-2	*Photoelectric effect*	*Orthogonality of energy eigenfunctions*	*comparison with the infinite square well potential*	*Method of separation of variables: separation of theta and phi equations*	*Spin operators*
S-3	SLO-1	*Compton effect*	*Postulates of quantum mechanics: wave function and the Born interpretation*	*Introduction to the barrier penetration problem*	*Solution of phi equation quantization of the magnetic quantum number m*	*Commutation relations among spin operators*
	SLO-2	*Derivation of Compton shift*	*Dirac notation*	*Step potential barrier: wave functions at boundaries/interfaces*	*Solution of theta equation quantization of orbital quantum number l*	*Spinors*
S-4 to S-5	SLO-1	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2					
S-6	SLO-1	*Particle like properties of waves and wave like properties of particles*	*Observables in operator form*	*Solution for the potential barrier and exact treatment of the wave function*	*Polar plots of angular wave Functions*	*Construction of Pauli spin matrices*
	SLO-2	*de-Broglie hypothesis*	*Hermitian operators' definition*	*Reflection, transmission coefficients and its dependence on energy and width*	*Spherical harmonic functions and their orthogonality relations*	*Properties of Pauli spin matrices*
S-7	SLO-1	*Davisson and Germer's experiment*	*Properties of Hermitian operators*	*Quantum mechanical tunnelling in 1D*	*Radial equation for hydrogen atom*	*Eigenvalues of Pauli spin matrices*

	SLO-2	*Free particle wave functions*	*Quantum mechanical eigenvalue equations*	*Expression for tunnelling probability*	*Solutions for radial equation of hydrogen atom*	*Eigenvectors of Pauli spin matrices*
S-8	**SLO-1**	*Difficulty with normalization of free particle wave function*	*Quantum mechanical expectation values*	*Simple harmonic oscillator in 1D using algebraic method*	*The uncertainty principle and quantization of angular momentum direction and magnitude*	*Electron in a magnetic field*
	SLO-2	*Wave packets and its integral representation*	*Position, momentum and energy expectation values of a free particle*	*Raising and lowering operators and their commutation relation*	*Angular momentum operators and ladder operators*	*Larmor precession*
S-9 to S-10	**SLO-1**	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2					
S-11	**SLO-1**	*Group and Phase velocities: Relationship between group, wave and particle velocity*	*Probability current and continuity equation*	*Expression for energy eigenvalues and eigenfunctions using algebraic method*	*Hydrogen Atom: Eigenvalues and Eigen functions of L^2 and L_z*	*Addition of angular momenta*
	SLO-2	*Heisenberg position-momentum, energy-time uncertainty principle*	*Application of Schrodinger equation: particle in an infinite square well potential in 1D*	*Simple harmonic oscillator in 1D using analytic method*	*Commutation relations of angular momentum operators*	*C-G coefficients (qualitative discussion)*
S-12	**SLO-1**	*Applications of the uncertainty principle*	*Energy quantization, normalization and orthogonality of wave functions*	*Hermite polynomials*	*Schrodinger equation of hydrogen atom in terms of L^2 operator*	*System of two electrons*
	SLO-2	*Electrons cannot reside inside a nucleus*	*Probability distribution, expectation values of position and momenta*	*Expression for simple harmonic oscillator energy quantization*	*Degeneracy of the energy Eigen values*	*Singlet and Triplet states*
S-13	**SLO-1**	*commutators*	*Generalized uncertainty relation*	*Energy eigen values, zero-point energy and uncertainty principle*	*Conservation of angular momentum in hydrogen atom*	*Addition of orbital and spin angular momenta*
	SLO-2	*position- momentum commutation relation*	*application to position and momentum operators*	*Calculation of expectation values for harmonic oscillator problem*	*Hydrogen atom spectrum Expression for energy of hydrogen-like atoms*	*Allowed values of J*
S-14 to S-15	**SLO-1**	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars Positions expectation for harmonic oscillator and comparison with the classical picture*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2					

Learning Resources	1. Introduction to Quantum Mechanics, D. J. Griffiths (Pearson Education Inc. 2005) 2. Introductory Quantum Mechanics, R. L. Liboff (Addison-Wesley, 2003) 3. Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles, Robert Eisberg and Robert Resnick (Wiley, 2006) 4. Concepts of Modern Physics, Arthur Beiser (McGraw Hill, 2009)	5. Quantum Mechanics, B. H. Bransden, and C. J. Joachain, (Pearson, 2000) 6. Schaum's outline of theory and problems of quantum mechanics Y. Peleg, R. Pnini, E. Zaarur, (McGraw-Hill, 1998). 7. Quantum Mechanics: 500 Problems With Solutions,Aruldhas G (PHI Learning private limited,2010)

Learning Assessment

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

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

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Dr. Ranjit Kumar Nanda, IIT Madras, nandab@iitm.ac.in	Dr. Ranjit Kumar Nanda, IIT Madras, nandab@iitm.ac.in	*Dr. Subhojyoti, SRMIST*

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Course Code	UPY23402J	Course Name	Solid State Physics	Course Category	C	Professional core course	L	T	P	O	C
							3	0	3	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	gain knowledge on crystallography and crystal structure			
CLR-2 :	acquire knowledge of x-ray and elastic waves in solids			
CLR-3 :	understand the fundamental of thermal and electrical conductivity			
CLR-4 :	gain knowledge on different types of electronic effects			
CLR-5 :	understand the spin related effect in materials			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related	Procedural Knowledge	Skills in Specialization	Ability to Utilize	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	explain the crystal structure of a solid material	2	75	60	H	H	-	-	-	-	-	-	-	-	-	H	H	H	-
CLO-2 :	analyze the x-rays and elastic waves in solids	2	80	70	H	H	-	-	-	-	-	H	-	-	-	-	H	H	-
CLO-3 :	apply the concept of thermal conductivity and electrical conductivity in solids	2	70	65	H	H	-	-	-	M	-	-	-	-	-	-	H	H	-
CLO-4 :	implement the understanding of electronic effect in different materials	2	70	70	-	H	-	-	-	H	-	-	-	M	-	-	-	H	-
CLO-5 :	explain the origin of various types of magnetic order	2	80	70	H	-	-	-	-	-	-	H	-	-	-	H	H	-	-

Duration (hour)		18	18	18	18	18
S-1	SLO-1	Overview of Solid State Physics	X-ray diffraction	Lattice vibrations	Free electron theory	Introduction to Magnetism
	SLO-2	Types of solids	Bragg's law for diffraction	Monoatomic and diatomic lattice vibrations	Fermi energy	Types of magnetism
S-2	SLO-1	Bonding in solids	Structure factor	Dispersion relation comparison	Bloch theorem	Landau Diamagnetism
	SLO-2	Basis	Form factor	Acoustical and optical branches	Electrons in periodic potential	Pauli's Paramagnetism
S-3	SLO-1	Primitive cell, Lattice	X-ray peak position	Phonon	Kronig-Penny model	Ferromagnetism
	SLO-2	Wigner-Sitz cell, shape of general 2D lattice	peak intensity, FWHM	Phonon momentum and energy	Energy bands	Heisenberg Exchange interaction
S-4 to S-6	SLO-1	Overview of different experiments	Determine interplanar spacing in crystal using x-ray diffraction	Thermal conductivity of bad conductor using Lee's disc	Band gap determination of a silicon diode	Two probe and four probe resistance measurement
	SLO-2	Error Analysis				
S-7	SLO-1	Symmetry	Atomic radii	Concept of density of states	Band-gap formation	Magnetic susceptibility
	SLO-2	Crystal System	Estimation of atomic radii	Phonon density of states	Metals, semiconductors and insulators	Magnetization hysteresis
S-8	SLO-1	Bravais Lattice in 2D	Attractive Interaction	Debye's model of specific heat	Effective mass	Magnetic anisotropy
	SLO-2	Bravais Lattice in 3D	Repulsive Interaction	Specific heat in low T limit	Motion of electron in electric and magnetic fields	Magnetic domain
S-9	SLO-1	Miller indices for Cubic system	Lennard-Jones potential	Specific heat in high T limit	Hall Effect	Superconductivity: Experimental survey
	SLO-2	Miller indices for hexagonal system	Madelung constant	Einstein's vs Debye's model comparison	Hall Coefficient and its sign	Application of Superconductivity
S-10 to S-12	SLO-1	Practice session for Miller indices calculation	Young's modulus determination	Stefan's constant	Estimating carrier concentration using Hall effect of a semiconductor	Magnetization measurement of bulk ferromagnet using vibrating sample magnetometer
	SLO-2					
S-13	SLO-1	Packing Fraction Calculation	Concept of elastic strain and stress in crystal	Thermal conductivity	Introduction to Dielectrics	Type I and Type II superconductor

	SLO-2	*Lattice Translation vectors*	*Definition of elastic stiffness and elastic compliance*	*Mechanism of thermal conductivity*	*Dipole moment and Polarization*	*Effect of magnetic field on superconductor*
S-14	**SLO-1**	*Reciprocal Lattice*	*Elastic waves in cubic crystal*	*Qualitative description of electronic contribution to specific heat*	*Macroscopic electric field*	*Thermodynamics of superconducting transition*
	SLO-2	*Reciprocal lattice of sc, bcc and fcc*	*Quantization of elastic waves*	*Electrical conductivity*	*Dielectric susceptibility*	*Free energy of superconductor*
S-15	**SLO-1**	*Brillouin Zone*	*Propagation of elastic waves along [100] direction*	*Drude's model*	*Clausius-Mossotti relation*	*Derivation of free energy*
	SLO-2	*Construction of Brillouin zone*	*Propagation of elastic waves along [110] and [111] direction*	*Weidemann-Frenz's law*	*Ferroelectricity*	*Energy gap in superconductor*
S-16 to S-18	**SLO-1**	*Identification of planes in x ray diffraction*	*Problems solving related to atomic-radii calculation*	*I-V Characteristics of LDR*	*Determine temperature coefficient of resistance of semiconductor*	*Repeat/revision of experiments*
	SLO-2					

Learning Resources	1. *C. Kittel, Introduction to Solid State Physics, 8th Ed., J. Wiley and Sons, 2005.* 2. *A.J. Dekker, Solid State Physics, Macmillan, 2009.*	3. *N.W. Ashcroft and D.M. Mermin, Solid State Physics, Holt, Rinehart and Winston, 1976.*

Learning Assessment

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

CLA – 4 can be from any combination of these: Assignments, Seminars, 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. R Seshadri, Titan Company Limited, seshadri@titan.co.in	Dr. Ranjit Kumar Nanda, IIT Madras, nandab@iitm.ac.in	*Dr. Jaivardhan Sinha. SRMIST*
Dr. M Satish, CSIR-CECRI, msathish@cecri.re.in	Dr. M Satish, CSIR-CECRI, msathish@cecri.re.in	*Dr. Madhuparna, SRMIST*

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Course Code	UPY23403J	Course Name	Electronics	Course Category	C	Professional core course	L	T	P	O	C
							3	0	3	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	understand the concept of networks and semiconductors diodes			
CLR-2 :	know the working principles of a transistors			
CLR-3 :	familiarize the operation of amplifiers			
CLR-4 :	differentiate the concepts of various kind of electronic oscillators and Operational amplifier			
CLR-5 :	learn the use of electronic component for its real applications.			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	apply skills to solve the circuits and being familiar with various kinds of diodes.	2	75	60	H	H	-	-	-	H	-	-	-	-	-	-	-	-	-
CLO-2 :	enable the students to explore the field of transistors	2	80	70	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
CLO-3 :	understand the concepts and working principles in amplifiers	2	70	65	-	H	-	-	-	H	-	-	-	H	-	-	-	-	-
CLO-4 :	learn the fabrication of electronic oscillators by using electronic componenets	2	70	70	-	H	-	-	-	H	-	-	-	H	-	-	-	-	-
CLO-5 :	use the fabricated device for real world applications	2	80	70	-	H	-	-	-	H	-	-	-	H	-	-	-	-	-

Duration (hour)		18	18	18	18	18
S-1	SLO-1	Circuit elements	Bipolar Junction Transistors-	RC coupled single stage amplifier- Construction	Oscillator operations- Barkhausen Criteria	Clipping circuits-Positive clipper
	SLO-2	Kirchhoff's Laws	BJT: construction, and working	RC coupled single stage amplifier- Operation- Frequency response	Principle of oscillators	Negative clipper
S-2	SLO-1	Methods of analyzing circuits- Mesh and Nodal Method	Physics/mechanism of PNP/NPN transistor	Introduction to power amplifiers	Hartley's oscillator	Biased clipper
	SLO-2	Thevenin's Theorem	CE configuration	Classification of power amplifiers	Colpitts's oscillators	Combination clipper
S-3	SLO-1	Norton's theorem	CE Input and output characteristics	Class A amplifier	Phase shift oscillator	Applications of clipper
	SLO-2	Maximum power transfer theorem	CB Configuration	Class A amplifier: Construction/Working	Wien's bridge oscillator	Problems/Demos/ Simulations/Seminars
S-4 to S-6	SLO-1	Basic Experimentation- Demo Class	Study the IV characteristics of Zener diode and note down its breakdown potential	CE amplifier and make the (i) Upper cut-off (ii) Lower cut-off frequencies and hence estimate the Bandwidth.	Design of Hartley/ Colpitts Oscillator	Making of Clipper and clamper circuit and analyze their response
	SLO-2					
S-7	SLO-1	Intrinsic and Extrinsic Semiconductor	CB Input and output characteristics	Class B amplifier	Operational Amplifiers (op-amp),	IC555 (Timer IC)
	SLO-2	PN junction diode– construction	Problems/Demos/ Simulations/Seminars based on BJT circuit	Class B amplifier: Construction/Working	Open loop and closed loop op-amp characteristics	Astable-multivibrator
S-8	SLO-1	Biasing of PN junction- VI characteristics of diode	Introduction to Two port networks	Class AB amplifier	Ideal op-amp with virtual ground	Astable-multivibrator construction/working
	SLO-2	Problem formulation on doping and PN junction	Two port network analysis and Problems/Demos/ Simulations/Seminars	Solving problems on power amplifier efficiency	Inverting op-amp	Monostable-multivibrator
S-9	SLO-1	Zener Diode-VI Characteristics	FET – Construction	Class C amplifier	Non-inverting op-amp	Monostable-multivibrator

	SLO-2	*Solving Problems on Zener diode as voltage regulator*	*Characteristics of JFET*	*Class C amplifier: Construction/Working*	*Op-amp Adder*	*Problems/Demos/ Simulations/Seminars*
S-10 to S-12	**SLO-1**	*Verification of circuit theorem*	*Obtain the characteristics curves of BJT in CE Configuration*	*Design Class A amplifier and analyze its response*	*Mathematical operation of Op-amp.*	*Study of timer circuit using IC555 and configuration for monostable and astable-multivibrator.*
	SLO-2					
S-13	**SLO-1**	*Schottky diode*	*Biasing of JFET*	*Class A Push pull amplifier*	*Op-amp Subtractor*	*Photodiode*
	SLO-2	*Schottky diode construction, working*	*Depletion and Enhancement Mode*	*Class A Push pull amplifier: Construction/Working*	*Op-amp Voltage follower*	*Phototransistor*
S-14	**SLO-1**	*Tunnel diode*	*Depletion type MOSFET*	*Class B Push pull amplifier*	*Op-amp as comparator*	*Photoconductivity*
	SLO-2	*Tunnel diode construction, working*	*Enhancement type MOSFET*	*Class B Push pull amplifier: Construction/Working*	*Solving problems on Op-amp applications*	*Photoconductive Cells/solar cell*
S-15	**SLO-1**	*Temperature dependent IV characteristics of Schottky diode*	*Physics/mechanism of MOSFET*	*Feedback amplifier*	*Op-amp as intergrator, differentiator*	*Type of solar cell and working*
	SLO-2	*Temperature dependent IV characteristics of Schottky diode*	*Problems/Demos/ Simulations/Seminars of MOSFET*	*Comparing types of amplifiers*	*Solving problems on Op-amp Applications-2*	*Light emitting diode*
S-16 to S-18	**SLO-1**	*Obtain the static characteristics of a PN junction diode and then obtain the forward resistance of the diode at a given operating point.*	*Obtain the Drain and Transfer characteristics of FET*	*Design Class B amplifier and analyze its response*	*Make the circuit of Integrator using Op-amp and analyze its response*	*Overall repetition*
	SLO-2					

Learning Resources	1. Principles of Electronics, Metha V.K., Mehta R. (S. Chand and Company Ltd., 2008) 2. Foundations of Analog and Digital Electronic Circuits, Anant Agarwal, Jeffrey Lang, (Morgan Kaufman, 2005) 3. Electron Devices and Circuits, Jacob Millman, Christos C Halkias, SatyabrataJit (Tata McGraw Hill, 2010)	4. Electronic Devices and Circuit Theory, Robert L. Boylestad and Louis Nashelsky (Pearson Education, 9th Edition, 2009).

Learning Assessment

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

CLA – 4 can be from any combination of these: Assignments, Seminars, 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. M Satish, CSIR-CECRI, msathish@cecri.re.in	Dr. Rajesh Kumar, IIT Indore, rajeshkumar@iiti.ac.in	*Dr. Shailendra Kumar Saxena, SRMIST*
Dr. V. Jayaraman, IGCAR, Kalpakkam, vjram@igcar.gov.in	Dr. V Gunasekaran, Central University TN, gunasekaran@cutn.ac.in	*Dr. A Geetha, SRMIST*

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Course Code	ULT23AE2J	Course Name	Applied Tamil – II	Course Category	AE	Ability Enhancement Courses (AE)	L	T	P	O	C
							1	0	2	2	2

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

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

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

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

Duration (hour)		9	9	9	9	9
S-1	SLO-1	தமிழில் அகராதிகள்	நேர்காணல் அறிமுகம்	விமர்சனம் – அறிமுகம்	பேச்சுக்கலை	கணினித்தமிழ்
	SLO-2	ஒரு மொழி/ இருமொழி அகராதி	ஆளுமைத்திறன்	விமர்சனத்தின் நோக்கம்	பேச்சின் அடிப்படைகள்	கணினி வழித் தட்டச்சு
S-2	SLO-1	பன்மொழி அகராதி	நோக்கம் – கண்டறிதல்	விமர்சன வகைகள்	தன்னம்பிக்கையும் பேச்சும்	தட்டச்சு செய்யும் மென்பொருட்கள்
	SLO-2	உயிர்/ மெய் எழுத்துகள்	நேர்காணல் முறைகள்	இலக்கிய விமர்சனம்	பேச்சின் வகைகள்	எழுத்துருக்கள்
S-3	SLO-1	உயிர்மெய் எழுத்துகள்	இனிய சொற்கள் பயன்பாடு	திரை விமர்சனம்	மேடைப் பேச்சு	யூனிகோடு எழுத்துருக்கள்/ பிற எழுத்துருக்கள்
	SLO-2	அகராதிக்கான அடிப்படைகள்	நேர்காணல் வகைகள்	கலை விமர்சனம்	பட்டிமன்றப் பேச்சு	குரல் வழி தட்டச்சு
S-4	SLO-1	அகராதி உருவாக்கப் பயிற்சி	நேரடியாக வினா விடை	விமர்சகர் தகுதிகள்	சொற்பொழிவு முறை	எழுத்து வழி தட்டச்சு
	SLO-2	அகராதி உருவாக்கப் பயிற்சி	அச்சு ஊடக நேர்காணல்	தேர்ந்த புலமை	பேச்சின் நுட்பங்கள்	தட்டச்சு செய்யும் பயிற்சி

S-5	SLO-1	கலைச்சொல் அறிமுகம்	காட்சி ஊடக நேர்காணல்	எழுத்துவடிவ விமர்சனம்	பேச்சாளர்களும் பேசும் முறைகளும்	தட்டச்சு செய்யும் பயிற்சி
	SLO-2	பிறமொழிச் சொற்களும் தமிழில் கலைச் சொற்களும்	கேட்பு ஊடக நேர்காணல்	காட்சி வடிவ விமர்சனம்	பேச்சு - எடுத்துரைப்பும் உடல்மொழியும்	பிழை திருத்திகள்
S-6	SLO-1	கலைச்சொல்லாக்க நெறிமுறைகள்	கள ஆய்வில் நேர்காணல்	விமர்சனம் செய்யும் பயிற்சி	நவீன தொழில்நுட்பங்களில் பேச்சு முறைகள்	தமிழில் பிழை திருத்தம் செய்யும் மென்பொருட்கள்
	SLO-2	கலைச்சொல் உருவாக்க உத்திகள்	நேர்காணல் செய்யும் பயிற்சி	விமர்சனம் செய்யும் பயிற்சி	பேச்சாளர்க்குரிய தகுதிகள்	வலைப்பூ உருவாக்கம்
S-7	SLO-1	துறைசார் சொற்கள்	நேர்காணல் செய்யும் பயிற்சி	செய்தியறிக்கை	பேச்சுப் பயிற்சி	வலைப்பூவில் எழுதும் முறைகள்
	SLO-2	புதிய கண்டுபிடிப்புகளும் கலைச்சொற்களும்	செய்தி வாசிப்பு முறைகள்	சமூக நிகழ்வை எழுதுதல்	பேச்சுப் பயிற்சி	வலைப்பூவின் பயன்கள்
S-8	SLO-1	பயன்பாட்டுச் சொற்கள்	செய்தி வாசிப்பு நுட்பங்கள்	செய்தியாளர்க்குரிய தகுதிகள்	கலந்துரையாடலின் நோக்கம்	தமிழ் இணைய நூலகங்கள்
	SLO-2	கலைச்சொல்லாக்கப் பயன்பாடுகள்	உச்சரித்தல்	உற்றுநோக்குதல்	கலந்துரையாடலின் தனித்தன்மைகள்	இணைய நூலகப் பயன்பாடுகள்
S-9	SLO-1	கலைச்சொல் உருவாக்கப் பயிற்சி	பிழையின்றி வாசித்தல்	சமநிலையில் எழுதுதல்	தம் கருத்தைத் தெளிவாக உரைத்தல்	தமிழ்த் தொடரடைவுகள்
	SLO-2	கலைச்சொல் உருவாக்கப் பயிற்சி	வாசித்தலும் உணர்வும்	செய்தியறிக்கை தயாரித்தல்	கலந்துரையாடல் பயிற்சி	தொடரடைவின் பயன்பாடுகள்

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

Learning Assessment

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

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

Course Designers

Experts from Industry	Expert from Higher Technical Institutions	Internal Experts
1. Dr. P.R.Subramanian, Director, Mozhi Trust, Thiruvanmiyur, Chennai – 600 041.	*1. Dr. V. Dhanalakshmi, Associate Professor, Subramania Bharathi School of Tamil Language & Literaturel, Pondicherry University, Pondicherry*	*1. Dr. B.Jaiganesh, Associate Professor & Head, Dept. of Tamil, FSH, SRMIST, KTR*
		2. Dr. R. Ravi, Assistant Professor and Head, Dept. of Tamil, FSH, SRMIST, VDP.
		3. Mr. G. Ganesh, Assistant Professor, Dept. of Tamil, FSH, SRMIST, RMP.
		4. Dr. T.R.Hebzibah beulah Suganthi, Assistant Professor, Dept. of Tamil, FSH, SRMIST, KTR.
		5. Dr. S.Saraswathy, Assistant Professor, Dept. of Tamil, FSH, SRMIST, KTR.

Course Code	ULH23AE2J	Course Name	APPLIED HINDI-II	Course Category	AE	Ability Enhancement Courses (AE)	L	T	P	O	C
							1	0	2	2	2

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

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

		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	To find and analyze different types of Cinema			
CLR-2 :	To Discover the print Media in the present World			
CLR-3 :	Writing report for Employability			
CLR-4 :	Writing Reviews and Create Job Oriented learning			
CLR-5 :	To Acquire technical words for various job Prospects			
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			
CLO-1 :	To Understand the History and Documentary in Hindi Cinema	2	75	80
CLO-2 :	To Comprehend Media Studies	2	80	90
CLO-3 :	To Evaluate report Writing	2	75	95
CLO-4 :	Enhance their Writing Skills in Media Studies	2	80	90
CLO-5 :	To Understand and usage of technical words in Hindi	2	85	90

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

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

Learning Resources	***Edited Book: "PRAYOJAN MULOK HINDI", SRIJONLOK PUBLICATION, 2023, New Delhi.*** 1. Film Banti Hai aur Banati Bhi hai, Lekhika – Sonal, Neolit Publication 2. https://navbharattimes.indiatimes.com/entertainment/movie-review/articlelist/2325387.cms?curpg=3 3. https://epustakalay.com/book/4858-hindi-patrakarita-by-dr-krishnbihari-mishra/ 4. https://hindisamay.com/ 5. https://rajbhasha.gov.in/hi/hindi-vocabulary

Learning Assessment

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

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

Course Designers

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

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

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

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

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

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

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

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

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

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

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

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

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*understand Random Variables, Probability, and Probability Functions*			
CLR-2 :	*understand measures of Centrality, Variance, and Covariance*			
CLR-3 :	*understand ideas of Regression*			
CLR-4 :	*understand the idea of Statistical Confidence*			
CLR-5 :	*understand Hypothesis Testing*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*represent Data in different types of Graphical and Tabular forms*	2	75	60
CLO-2 :	*form Samples of Data and construct estimators for mean, variance, and covariance*	2	80	70
CLO-3 :	*fit functions to and estimate model parameters from data*	2	70	65
CLO-4 :	*test hypotheses given a data sample*	2	70	70
CLO-5 :	*express statements in terms of Statistical Confidence Intervals*	2	80	70

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

Duration (hour)		12	12	12	12	12
S-1	SLO-1	*Types of Data*	*Normal Distribution*	*Parameter Estimation*	*χ^2 Cumulative*	*Goodness of Fit*
	SLO-2	*Representation of Data*	*Moments of Normal Distribution*	*Estimators for Mean, Variance, and Cov*	*χ^2 Confidence Intervals*	*Examples*
S-2	SLO-1	*Probability*	*Poisson Distribution as Limiting case of Binomial*	*Linear Regression*	*Likelihood Functions*	*t-distribution and t-statistic*
	SLO-2	*Random Variables*	*Normal Approximation*	*Least Square Estimation of Regression Parameters*	*Properties of ML Estimators*	*Conditions for t-testing*
S-3	SLO-1	*Probability Mass Function*	*Operations on a Normal Variable*	*Derivation of LLS estimators*	*ML with binned data*	*One sample test*
	SLO-2	*Probability Density Function*	*Operations on two Normal Variables*	*Derivation of LLS*	*Examples*	*Two sample test*
S-4	SLO-1	*Introduction to Python*	*Random Numbers from different distributions in Numpy*	*Least Square Fit Using Scipy*	*CI with open data: Chemistry*	*GoF: Epidemiology*
	SLO-2					
S-5	SLO-1	*Mean and Variance as Moments*	*Joint PDF*	*Bias and Consistency*	*CI with ML*	*Correlation between samples*
	SLO-2	*Skewness and Kurtosis*	*Marginal Distributions*	*Convergence and Robustness*	*Case Studies*	*Paired Testing*
S-6	SLO-1	*Cumulative Distributions*	*Covariance*	*Least Square for Polynomials*	*Combining Measurements with ML*	*Proportion testing*
	SLO-2	*Examples: Percentiles*	*Covariance Matrix*	*Examples*	*Estimated Variance*	*Applications of Proportion testing*
S-7	SLO-1	*Bernoulli Trial*	*Error Propagation*	*Least Squares with Binned Data*	*Hypothesis Testing*	*Introduction to Bayesian Statistics*
	SLO-2	*Binomial Distribution*	*Error Propagation with Covariance*	*Normalisation*	*Binary Classification*	*Prior and Posterior*
S-8	SLO-1	*Introduction to Numpy Arrays*	*Marginal Distributions and Joint PDFs*	*Binned Data Fit Using Scipy*	*ML to fit function with open data: Economics*	*Paired t-test: Nutrition*
	SLO-2					
S-9	SLO-1	*Moments of Binomial Distribution*	*Statistical and Systematics Error*	*Confidence Interval (CI)*	*p-value*	*Bayesian Estimation*
	SLO-2	*Cumulative Binomial*	*Statistical Error as Variance*	*CI for Normally Distributed Estimator*	*Confidence Level*	*Connecting ML to Bayesian Estimation*

S-10	**SLO-1**	*Counting Statistics*	*Population and Sample*	*χ^2 Distribution`*	*Likelihood Ratio*	*Bayesian Testing*
	SLO-2	*Poisson Distribution*	*Sample Mean and Variance*	*Degrees of Freedom*	*Likelihood Ratio Test*	*Examples of Bayesian Testing*
S-11	**SLO-1**	*Moments of Poisson Distribution*	*Law of Large Numbers (Statement)*	*χ^2 from a Normal Distribution*	*χ^2 test*	*Bayesian Credibility*
	SLO-2	*Counting Statistics*	*Central Limit Theorem (Statement)*	*The variance of Normally Distributed Samples*	*Pearson's and Neyman's χ^2 test*	*Credible intervals*
S-12	**SLO-1**	*Plotting in Matplotlib*	*Visualising the Law of Large Numbers and the Central Limit Theorem*	*Counting Experiments: Decay*	*Likelihood Ratio Test: Atmospheric Science*	*Bayesian A/B testing: Retail*
	SLO-2					

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

Learning Assessment

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

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

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

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

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Understand the concept of sets, relations and functions	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	Gain knowledge on the basics of logic			
CLR-3 :	Obtain the knowledge on polynomial equations			
CLR-4 :	Gain knowledge on Matrices and its applications			
CLR-5 :	Comprehend the working principle of various calculus techniques			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	Acquire the knowledge on sets and functions	3	80	85
CLO-2 :	Gain the ability to identify science and engineering problems logically	1	75	80
CLO-3 :	Understand the basic ideas about polynomial equations	3	85	80
CLO-4 :	Appreciate the concepts of Matrices in real life situations	3	80	75
CLO-5 :	Apply the knowledge of different calculus techniques	1	75	85

Program Learning Outcomes (PLO)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	M	H	-	-		-	-	-	-	-	-	H	-	-	-
CLO-2 :	M	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	M	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	M	-	-	H	-	-	-	-	-	-	-	-	-	-	-

Duration (Hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-1	SLO-1	Sets - sets definition and representation of sets	Statements	Polynomial equations	Symmetric matrices,	Introduction to calculus
	SLO-2	Examples for sets and representations	Examples for statements	Examples for Polynomial equations	Skew symmetric matrices	Differential calculus - Introduction
S-2	SLO-1	Types of sets, operation on sets, Venn diagram	connectives, conjunction	Irrational roots	Hermitian, skew Hermitian matrices	Maxima and minima-Introduction
	SLO-2	Examples for types of sets and operations on sets	Examples for connectives, conjunction	Problems on irrational roots	Examples for different types of matrices	Simple problems on maxima and minima of functions of single variable
S-3	SLO-1	Relation - Types of Relation	Disjunction, negation	complex roots(up to third order equations only)	Orthogonal, Unitary matrices	More problems on maxima and minima
	SLO-2	Examples for types of relation	Examples for Disjunction, negation	Problems on equations with complex roots	Examples for Orthogonal, Unitary matrices	More problems on maxima and minima
S-4	SLO-1	Tutorial	Tutorial	Tutorial	Tutorial	Tutorial
	SLO-2	Tutorial	Tutorial	Tutorial	Tutorial	Tutorial
S-5	SLO-1	Equivalence Relation	Tautology, Contradiction	Reciprocal equations	Cayley Hamilton Theorem	More problems on maxima and minima
	SLO-2	Examples and problems on equivalence relation	Problems on tautology, contradiction	Problems on reciprocal equation	Problems on Cayley Hamilton Theorem	Radius of curvature – Introduction
S-6	SLO-1	Function - Introduction	logical equivalence	Approximation of roots of a polynomial equation	Problems on Cayley Hamilton Theorem	Problems on Radius of curvature- Cartesian co – ordinate
	SLO-2	Types of functions	Examples for logical equivalence	Newton's Method-Introduction	Eigen values– Eigen vectors	Problems on Radius of curvature
S-7	SLO-1	Problems for different functions	tautological implications	Newton's method- Finding positive roots	Problems on Eigen values– Eigen vectors	More problèmes on radius of curvature
	SLO-2	Composite of two functions	Examples for tautological implications	More problems Newton's method- Finding positive roots	Problems on Eigen values– Eigen vectors	Partial differentiation

S-8	SLO-1	Tutorial	Tutorial	Tutorial	Tutorial	Tutorial
	SLO-2	Tutorial	Tutorial	Tutorial	Tutorial	Tutorial
S-9	SLO-1	Examples for composite functions	Arguments , Validity of arguments	Problems on Newton's method- Finding reciprocal of a given number	Problems on Eigen values– Eigen vectors	Problems on partial differentiation
	SLO-2	Composite of three functions	Normal forms	Problems on Newton's method- Finding Square root of a given number	Problems on Eigen values– Eigen vectors	More problems on partial diferentiation
S-10	SLO-1	Examples for composite of three functions	Principal disjunctive normal form	Horner's method- Introduction	Cramer's rule-Introduction	Euler's theorem- Introduction
	SLO-2	Problems on functions	Problems for pdnf	Horner's method Finding positive roots	Solving system of linear equations- Crammer's rule	Problems on Euler's theorem
S-11	SLO-1	Problems on composite of two functions	Principle conjunctive normal form	Problems on Horner's method- finding roots between given values	Problems on Crammer's rule	More Problems on Euler's theorem
	SLO-2	Problems on composite of three functions	Problems for pcnf	More Problems on Horner's method	More Problems on Crammer's rule	More Problems on Euler's theorem
S-12	SLO-1	Tutorial	Tutorial	Tutorial	Tutorial	Tutorial
	SLO-2	Tutorial	Tutorial	Tutorial	Tutorial	Tutorial

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

Learning Assessment

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

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

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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	2. Dr. B. V. Rathish Kumar, IIT Kanpur bvrk@iitk.ac.in	2. Dr. N. Balaji, SRMIST balajin@srmist.edu.in

Course Code	UPY23S02T	Course Name	Python Programming	Course Category	S	Skill enhancement course	L	T	P	O	C
							0	2	0	2	2

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:*
CLR-1 :	*develop programming skill in python*
CLR-2 :	*develop basic problem-solving skill through use of mathematics and statistics*
CLR-3 :	*understand programming structure of python language*
CLR-4 :	*enable the students to handle data related to physical experiments and theory*
CLR-5 :	*apply exploratory data analysis and generate basic statics for unfamiliar data sets.*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning 1 Level of Thinking (Bloom)	Learning 2 Expected Proficiency (%)	Learning 3 Expected Attainment (%)	PLO 1 Fundamental Knowledge	PLO 2 Application of Concepts	PLO 3 Link with Related	PLO 4 Procedural Knowledge	PLO 5 Skills in Specialization	PLO 6 Ability to Utilize	PLO 7 Skills in Modeling	PLO 8 Analyze, Interpret Data	PLO 9 Investigative Skills	PLO 10 Problem Solving Skills	PLO 11 Communication Skills	PLO 12 Analytical Skills	PLO 13 PSO -1	PLO 14 PSO -2	PLO 15 PSO-3
CLO-1 :	*demonstrate good programming skill*	*2*	*75*	*60*	H	H	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-2 :	*use basic programming constructs, including sequence, selection and iteration, the use of identifiers, variables and expressions, and a range of data types*	*2*	*80*	*70*	H	H	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-3 :	*employ fundamental mathematical and statistical concepts to solve physics problems*	*2*	*70*	*65*	H	H	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-4 :	*interpret experimental/observational results correctly*	*2*	*70*	*70*	H	H	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-5 :	*write code to analyse and present experimental/observational data*	*2*	*80*	*70*	H	H	-	-	-	-	-	-	-	-	-	H	-	-	-

Duration (hour)		6	6	6	6	6
S-1 to S-2	SLO-1	*Getting overview of the course and Setting up Python Environment Python Editors, Resources PythonIDE*	*Introduction to Python Environments and Distributions, CONDAS/ANACONDAS; EDITORS: Spyder, PyCharm, Visual Studio and Jupyter*	*Interpolation Curve Fitting - Fitting Exercises*	*Numerical Differentiation Simple Exercises*	*Data Manipulation and Analysis: Pandas Reading Data from Files Using Pandas Exercises*
	SLO-2					
S-3 to S-4	SLO-1	*Python Programming: Variables Numbers Strings String Built-in Functions Python Standard Library Packages and Modules Numpy, Scipy, Matplotlib Plotting in Python*	*Mathematics in Python: Basic Math Functions, Statistics functions in Python, Trigonometric Functions, Polynomials Exercises*	*Models to Data Linear Regression Exercises*	*Numerical Integration, Simple Exercises*	*Data Structures: Series and Data Frame Getting Data from the Web Exercises*
	SLO-2					
S-5 to S-6	SLO-1	*Python Programming II: Loops, creating functions, Classes, file handling, Debugging*	*Linear Algebra: Vectors, Matrices, Linear Algebra (numpy.linalg) Matrix Addition/Subtraction/Multiplication/ Transpose of a Matrix/Determinant/Inverse Matrix, Solving Linear Equations*	*Polynomial Regression Least Square Method Exercises*	*Discrete (Fast) Fourier Transforms Continuous and discrete Fourier transforms The SciPy FFT library*	*Extracting Information from a Data Frame Plotting with Pandas Grouping and Aggregation Exercises*
	SLO-2					

Learning Resources	1. David J. Pine, Introduction to Python for Science & Engineering 2. Hans-Petter Halvorsen Python for Science and Engineering	3. Hans Fangohr, Introduction to Python for Computational Science and Engineering,

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

CLA – 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. D. Sivaprakasam, Scientist F, ARCI, Chennai. sprakash@arci.res.in	Prof. B.S. Murthy, Director, IIT Hyderabad, bsm@iith.ac.in	Dr. A. Naga Rajesh, SRM IST
Dr. Ajay Singh, BARC, Mumbai, ajay@barc.gov.in	Prof. S Balakumar, University of Madras, balakumar@unom.ac.in	Dr. Rudra Banerjee, SRMIST

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Course Code	UCD23V05T	Course Name	Career Readiness and Professional Skills	Course Category	V	Value Addition Course	L	T	P	O	C
							2	0	0	2	2

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Enable students to understand reasoning skills and mathematical concepts	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	Prepare students for job interviews			
CLR-3 :	Learn structured query language (SQL) to an intermediate/advanced level			
CLR-4 :	Learn the benefits of Python as a scripting language			
CLR-5 :	Develop life-long skills students can use to seek jobs, internships and make career changes			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	ICT Skills	Professional Behavior	Life Long Learning
CLO-1 :	Solve the problems on reasoning	3	80	75	H	M	-	-	-	M	-	H	-	H	-	H	M	-	-
CLO-2 :	Face interviews confidently	3	80	75	-	-	M	-	M	-	-	-	L	-	H	-	-	H	H
CLO-3 :	Understand the importance and major issues of database security and the maintenance of data integrity	3	75	70	H	M	-	M	H	-	M	-	-	-	-	M	-	H	M
CLO-4 :	Utilise essential programming components including variables, conditional logic, loops, and functions to create simple programs	3	75	70	H	-	M	M	-	H	-	-	-	M	-	H	-	H	M
CLO-5 :	Assist students in choosing a career path during their course	3	75	70	-	M	M	-	H	-	M	-	-	-	H	-	-	H	H

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

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

Learning Assessment					
Level	Bloom'sLevel of Thinking	Continuous Learning Assessment (100% weightage)			
		CLA-1 (20%)	CLA-2 (20%)	CLA-3 (30%)	CLA-4 (30%)#
		Theory	Theory	Theory	Theory
Level 1	Remember	20%	10%	25%	25%
	Understand				
Level 2	Apply	50%	50%	50%	50%
	Analyze				
Level 3	Evaluate	30%	40%	25%	25%
	Create				
	Total	100 %	100 %	100 %	100 %

CLA-1, CLA-2 and CLA-3 can be from any combination of these: Online Aptitude Tests, Classroom Activities, Case Studies, Poster Presentations, Power-point Presentations, Mini Talks, Group Discussions, Mock interviews, etc.

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

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

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Course Code	UMI23M01L	Course Name	My India project	Course Category	M	Extension Activity/Community Outreach	L	T	P	O	C
							0	0	0	0	0

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

Course Offering Department	*Physics and Nanotechnology*	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	UPY23501J	Course Name	Quantum Mechanics II	Course Category	C	Professional core course	L	T	P	O	C
							3	0	2	2	4

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*learn the consequences of symmetries in quantum mechanics*			
CLR-2 :	*analyze the effect of electric and magnetic fields on atomic systems with time-independent perturbation theory*			
CLR-3 :	*apply time-dependent perturbation theory to atomic and molecular phenomena*			
CLR-4 :	*learn quantum mechanical scattering theory*			
CLR-5 :	*learn elements of relativistic quantum mechanics*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	*understand the concept of symmetry, conservation laws and degeneracy in quantum mechanics*	*2*	*75*	*60*	H	H	-	-	-	-	-	H	-	-	-	-	-	-	-
CLO-2 :	*learn the time-independent perturbation theory and its applications in atomic physics*	*2*	*80*	*70*	-	H	H	-	-	-	-		-	H	-	-	-	-	-
CLO-3 :	*learn the the time-dependent perturbation theory and its applications in spectroscopy*	*2*	*70*	*65*	-	H	H	-	-	-	-	-	-	H	-	-	-	-	-
CLO-4 :	*apply quantum mechanics to scattering problems*	*2*	*70*	*70*	H	H	H	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*familiarize with the fundamentals of relativistic quantum mechanics*	*2*	*80*	*70*	H	-	H	-	-	-	-	H	-	-	-	-	-	-	-

Duration (hour)		15	15	15	15	15
S-1	SLO-1	*Symmetries discrete vs continuous*	*Time-independent perturbation theory nondegenerate case general formulation*	*Time-dependent perturbation theory two-level system*	*The classical definition of scattering cross section and physical Interpretation of the cross section*	*Postulates of special theory of relativity*
	SLO-2	*Translation operator*	*Time-independent perturbation theory nondegenerate case – first order energy correction*	*Expression for probability amplitude Exact method*	*Scattering angle, impact parameter differential and total cross section*	*Four vectors*
S-2	SLO-1	*transformation of operators*	*Time-independent perturbation theory nondegenerate case – first order wave function correction*	*Expression for probability amplitude zeroth-order correction and first-order correction*	*Connecting the Lab and centre of mass angles*	*Lorentz transformation*
	SLO-2	*Translation symmetry*	*Time-independent perturbation theory nondegenerate case – second order energy correction*	*Constant perturbation and its connection with energy-time uncertainty relation*	*Connecting the Lab and centre of mass cross section*	*Difficulty with Schrodinger equation under Lorentz transformation*
S-3	SLO-1	*Discrete translation symmetry Bloch theorem*	*Time-independent perturbation theory degenerate case two-fold degeneracy*	*Sinusoidal perturbation*	*Quantum scattering theory*	*Klein-Gordon (K-G) equation*
	SLO-2	*Continuous translation symmetry momentum conservation*	*Removal of degeneracy*	*Expression for transition probability*	*Relation between differential cross section and scattering amplitude*	*Expressions for charge and current density*
S-4 to S-5	SLO-1	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2					
S-6	SLO-1	*Parity operator eigenvalues of*	*Stark effect - Hamiltonian*	*Fermi's golden rule*	*Schrodinger equation in integral form*	*K-G equation for a particle in electromagnetic field*

		the parity operator				
	SLO-2	*Inversion symmetry and its consequences*	*Stark effect in ground and first excited state of hydrogen atom*	*Fermi's golden rule for incoherent perturbation*	*Green 's Functions in scattering Theory*	*Nonrelativistic limit of the K-G equation*
S-7	**SLO-1**	*Pseudovectors and pseudoscalars*	*Normal and anomalous Zeeman effect Hamiltonian*	*Einstein's coefficient*	*Green's function for Laplacian and Helmholtz operator*	*Difficulty with K-G equation*
	SLO-2	*Laporte's rule*	*Normal Zeeman effect splitting of energy levels*	*Spontaneous emission, lifetime of excited states*	*Born's approximation*	*Dirac equation*
S-8	**SLO-1**	*Rotational symmetry generator of rotations*	*Anomalous Zeeman effect splitting of energy levels*	*Selection rule for m*	*Born's approximation for spherically symmetric potential (Yukawa scattering)*	*Dirac matrices and their properties*
	SLO-2	*Rotations in 3D*	*Paschen-beck effect*	*Selection rule for l*	*Born's approximation for spherically symmetric potential (Rutherford scattering)*	*Expressions for probability density and probability current*
S-9 to S-10	**SLO-1**	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2					
S-11	**SLO-1**	*Continuous rotational symmetry conservation of L*	*Relativistic correction - Hamiltonian*	*Variation theorem statement and proof*	*Partial wave analysis - formalism*	*Plane wave solutions to Dirac equation*
	SLO-2	*Symmetry, conservation laws, degeneracy*	*Relativistic correction expression for energy correction*	*Variation theorem verification for 1D systems*	*Partial wave amplitude*	*Relation between plane wave solutions and electron spin*
S-12	**SLO-1**	*Irreducible tensor operators (rank 0 and 1)*	*Spin-orbit coupling Hamiltonian*	*Ground state energy of helium atom*	*Rayleigh formula*	*Negative energy states and Positrons*
	SLO-2	*Wigner-Eckart theorem (only statement) and its applications*	*Expectation value of Estimation of L.S*	*Estimation of helium atom energy using effective nuclear charge*	*Phase shifts in 1D*	*Dirac equation of a particle in electromagnetic field*
S-13	**SLO-1**	*Time translations*	*Expression for energy correction due to fine structure*	*WKB approximation*	*Relation between phase shifts and partial wave amplitudes*	*Nonrelativistic limit of the Dirac equation of a particle in electromagnetic field*
	SLO-2	*Time-translation invariance*	*Energy level splitting due to fine structure*	*Applications to tunnelling problems*	*Optical theorem*	*Prediction of electron magnetic moment*
S-14 to S-15	**SLO-1**	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2					

Learning Resources		
	1. Introduction to Quantum Mechanics, D. J. Griffiths (Pearson Education Inc. 2005)	5. Quantum Mechanics, B. H. Bransden, and C. J. Joachain, (Pearson, 2000)
	2. Introductory Quantum Mechanics, R. L. Liboff (Addison-Wesley, 2003)	6. Schaum's outline of theory and problems of quantum mechanics Y. Peleg, R. Pnini, E. Zaarur, (McGraw-Hill, 1998).
	3. Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles, Robert Eisberg and Robert Resnick (Wiley, 2006)	7. Quantum Mechanics: 500 Problems With Solutions,Aruldhas G (PHI Learning private limited,2010)
	4. Concepts of Modern Physics, Arthur Beiser (McGraw Hill, 2009)	

Learning Assessment

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

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

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Course Code	UPY23502J	Course Name	Optics	Course Category	C	Professional core course	L	T	P	O	C
							3	0	3	2	4

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*acquire knowledge of basic ray optics*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*understand the concept of Interference*			
CLR-3 :	*study the fundamentals of diffraction and holography*			
CLR-4 :	*apply the concept of polarization of light and non-linear optics*			
CLR-5 :	*understand current developments of Fiber Optics and lasers*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related	Procedural Knowledge	Skills in Specialization	Ability to Utilize	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	*enable the students to explore the field of optics*	2	80	70	H	H	-	-	-	-	-	H	H	-	-	-	-	-	-
CLO-2 :	*understand the basic concepts in interference and optical sensors*	2	70	65	H	H	-	-	-	-	-	H	-	-	-	-	-	-	-
CLO-3 :	*apply the techniques of diffraction for several applications such as holography*	2	70	70	H	H	-	-	-	-	-	H	-	-	-	-	-	-	-
CLO-4 :	*utilize the concept of polarization for designing devices such as smart windows*	2	80	70	H	H	-	-	-	-	-	H	-	-	-	-	-	-	-
CLO-5 :	*understand the concepts in modern optics and laser technology*	2	75	70	H	H	-	-	-	-	-	H	-	-	-	-	-	-	-

Duration (hour)		18	18	18	18	18
S-1	SLO-1	*Light: Huygens Principle*	*Interference: Introduction*	*Diffraction: Introduction*	*Polarization: Malus's law*	*Optical Fiber: Concept*
	SLO-2	*Fermat Principal: Introduction*	*Condition for Interference*	*Fraunhofer- single slit diffraction*	*Production of polarized light*	*Numerical Aperture*
S-2	SLO-1	*Law of Refraction and Reflection*	*Coherence*	*Fraunhofer- double slit diffraction*	*s- and p- polarization*	*Attenuation in optical fiber*
	SLO-2	*Refraction at a single spherical surface*	*Temporal and Spatial Coherence*	*Fraunhofer- many slit diffraction*	*Dichroism*	*Guided modes in step index fiber*
S-3	SLO-1	*Reflection at a single spherical surface*	*Young's double slit experiment*	*Fraunhofer approximation*	*Birefringence*	*Single mode and multimode fiber*
	SLO-2	*Reflection at the plane surface (mirror)*	*Fresnel's two mirror arrangement*	*Fraunhofer diffraction by long narrow slit*	*Scattering and Polarization*	*Application of fiber optics*
S-4 to S-6	SLO-1	*Basics of Optics Experiments*	*Spectrometer i-i' curve*	*Determination of dispersive power of a prism using spectrometer*	*Spectrometer - Narrow angled Prism*	*Revision of experiments*
	SLO-2					
S-7	SLO-1	*Reflection at the spherical mirror*	*Fresnel's Biprism*	*Fraunhofer diffraction by rectangular aperture*	*Polarization by reflection*	*Fiber optic communication*
	SLO-2	*Total Internal Reflection*	*White light interference*	*Fraunhofer diffraction by circular aperture*	*Circular Polarizer*	*Fiber optic sensors*
S-8	SLO-1	*Lenses: Terminology*	*Fringe Displacement*	*Fresnel Diffraction*	*Interference of Polarized light: Quarter and Half wave plate*	*Laser Principle*
	SLO-2	*Thin lens: Equations*	*Interference by plane parallel film when illuminated by a plane wave*	*Fresnel half period zone*	*The phenomenon of double refraction*	*Einstein Coefficients and Optical Amplifications*
S-9	SLO-1	*Thin lens combinations*	*Interference by plane parallel film when illuminated by a point source*	*Fresnel Zone plate*	*Plane wave propagation in isotropic media*	*Population Inversion and metastable state*
	SLO-2	*Newton's Formula*	*Interference by film with two non-parallel reflecting surfaces*	*Fresnel Diffraction: More rigorous approach*	*Ray velocity and ray refractive index*	*Ruby laser*
	SLO-1					*Determination of numerical*

S-10 to S-12	**SLO-2**	*Determination of Mercury light wavelength spectrum using prism minimum deviation experiment*	*Determination of mercury spectrum wavelength using diffraction grating in minimum deviation*	*Determination of refractive index of prism material by drawing i-d curve.*	*Spectrometer-Refractive index of the liquid*	*aperture and acceptance angle of the optical fiber using laser*
S-13	**SLO-1**	*Lens Aberrations (A basic Introduction)*	*Newton's ring*	*Fresnel Integral and rectangular aperture*	*Non-linear optics: Basics*	*Typical Parameters of Ruby laser*
	SLO-2	*First Order Theory*	*Problem Solving: Newton's Ring*	Fresnel-diffraction by circular aperture	*Non-linear optics: Applications*	*He-Ne laser*
S-14	**SLO-1**	*Chromatic/Achromatic Aberrations*	*Michelson Interferometer*	*Fresnel Diffractive by Narrow Obstacle*	*Solving Problems: Half wave plate and quarter wave plate*	*Optical Resonators*
	SLO-2	*Graded Index lenses*	*Mach-Zehnder Interferometer*	*Diffraction at straight edge*	*Dispersion*	*Solving Problems: Fiber optics and numerical aperture*
S-15	**SLO-1**	*Camera (A basic working principle)*	*Fabry-Perot Interferometer*	*Solving Problem: Fraunhofer Diffraction*	*Brewster Angle*	*Solving Problems: He-Ne laser*
	SLO-2	*Microscope and Telescopes*	*Resolving Power*	*Solving Problem: Fresnel Diffraction*	*Abbe's Refractometer*	*Solving Problems: Ruby laser*
S-16 to S-18	**SLO-1**	*Determination of thickness of thin wire air wedge*	*Determination of sodium light wavelength: Newton Ring's method*	*Determination of mercury spectrum wavelength using diffraction grating at normal incidence*	*Repeat/Revision of Experiments*	*Spectrometer: Cauchy's constant*
	SLO-2					

Learning Resources	1. Optics, Ajoy Ghatak, (McGraw Hill, 2010). 2. Optics, Eugene Hecht, (4thEdition, Addison Wesley, 2002). 3. Modern Classical Optics, Brooker, Geoffrey, (Oxford Univ. Press, 2003) *4.* A Text Book of Optics, N. Subrahmanyam, Brij Lal, M. N. Avadhanulu, (S. Chand Limited, 2015)	*5. B.Sc., Practical Physics, C. L. Arora, (S. Chand & Company Ltd., 2007)* *6. Engineering Physics Practical, Gupta, Krishna Prakashan (Ninth Edition, Media publishers, 2010).* *7. Fundamentals of Optics, F. Jenkins and H White, (McGraw Hill, 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	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
	Understand										
Level 2	Apply	40%	40%	50%	50%	50%	50%	50%	50%	50%	50%
	Analyze										
Level 3	Evaluate	30%	30%	20%	20%	20%	20%	20%	20%	20%	20%
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

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

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. N Vijayan, NPL, nvijayan @nplindia.org	Prof. V Subramanian, IIT Madras, manianvs@iitm.ac.in	*Dr. Anand Mohan, SRMIST*
Mr. R Seshadri, Titan Company Limited, seshadri@titan.co.in	Dr. Maruthi Manoj Brundavanam, IIT Kharagpur, bmmanoj@phy.iitkgp.ac.in	*Dr. K Shadak Alee, SRMIST*

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Course Code	UPY23503J	Course Name	Advanced Electronics	Course Category	C	Professional core course	L	T	P	O	C
							3	0	3	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	understand the basic concepts of number systems
CLR-2 :	develop the digital circuit design concepts using logic gates
CLR-3 :	apply digital fundamentals in combinational/ sequential logic systems
CLR-4 :	understand basic concept and architecture of 8085 microprocessor and implement programs in 8085
CLR-5 :	familiarize the architecture of 8051 microcontroller and its programming

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning: Level of Thinking (Bloom)	Learning: Expected Proficiency (%)	Learning: Expected Attainment (%)	PLO 1 Fundamental Knowledge	PLO 2 Application of Concepts	PLO 3 Link with Related Disciplines	PLO 4 Procedural Knowledge	PLO 5 Skills in Specialization	PLO 6 Ability to Utilize Knowledge	PLO 7 Skills in Modeling	PLO 8 Analyze, Interpret Data	PLO 9 Investigative Skills	PLO 10 Problem Solving Skills	PLO 11 Communication Skills	PLO 12 Analytical Skills	PLO 13 PSO -1	PLO 14 PSO -2	PLO 15 PSO-3
CLO-1 :	apply the concepts of number system in digital electronics	2	75	60	H	H	-	-	-	-	-	H	-	-	-	-	-	-	-
CLO-2 :	understands the basic concepts of logic gates	2	80	70	H	H	-	-	-	-	-	H	-	-	-	-	-	-	-
CLO-3 :	utilize the concepts in logic systems	2	85	75	H	H	-	-	-	-	-	H	-	-	-	-	-	-	-
CLO-4 :	understand the architecture of 8085, and 8051	2	70	80	H	H	-	-	-	-	-	H	-	-	-	-	-	-	-
CLO-5 :	impart knowledge on instruction sets of 8085, and 8051	2	80	70	H	H	-	-	-	-	-	H	-	-	-	-	-	-	-

Duration (hour)		18	18	18	18	18
S-1	SLO-1	Introduction to Decimal number systems	Basic laws of Boolean algebra	Introduction to Flip-Flops	Introduction to Microprocessor 8085	Introduction to microcontroller and embedded system – 8051 microcontrollers
	SLO-2	Binary number systems-number base conversions	De– Morgan's theorems and Problems/Demos/ Simulations/Seminars	RS flip-flop	Internal registers (8-bit & 16-bit)-CPU-ALU	Architecture of 8051
S-2	SLO-1	Octal number systems	Reducing Boolean expressions using Boolean laws	Clocked RS Flip Flop	Types of System Bus-Bus Structure (address, data and control bus)	Architecture of 8051
	SLO-2	Hexadecimal number systems	Sum of Products (SOP) form of expressions	D flip-flop –	Architecture of Microprocessor 8085	Key features of microcontroller
S-3	SLO-1	Binary Coded Decimal (BCD) code	Product of Sum (POS) form of expressions	race around condition	Architecture of Microprocessor 8085	Internal RAM and ROM organizations
	SLO-2	Excess –3 code	Min term and max terms	JK flip-flop, T-Flip flop - Timing diagram	pin configuration of 8085.	Internal RAM and ROM organizations
S-4 to S-6	SLO-1	Basic Experimentation-Demo Class	De– Morgan's theorems-verifications	Truth table verification of various Flip- Flops	Assembly Language Programs to perform the Arithmetic operations (addition and Subtraction) using microprocessor 8085.	Assembly Language Programs to perform the Arithmetic operations (addition and Subtraction) using microcontroller 8051.
	SLO-2					
S-7	SLO-1	Gray code	Karnaugh map simplification	Master slave JK flip-flop	pin configuration of 8085.	Pin configuration of 8051
	SLO-2	Gray code to Binary code conversion	Karnaugh map simplification	Shift left registers	instructions–Timing and sequencing instruction cycles–Machine cycle of weight state	Pin configuration of 8051
S-8	SLO-1	Verification of truth tables using logic gates	Introduction to combinational logic circuits	Shift right registers	Timing diagram for Memory read and Memory write cycle.	Instruction set classification-8051 data types and directives
	SLO-2	*One's complement and two's complement*	*Half adder*	*SISO Shift register*	*Instruction set classification-based on number of bytes and number of operations*	*Data transfer instructions*
S-9	SLO-1	*Binary Addition*	*Full adders*	*SIPO Shift register*	*Data transfer instructions*	*Data transfer instructions*

	SLO-2	Binary Subtraction and solving problems on binary arithmetic operations	Half subtractor	Ripple counter	Details of data transfer instructions	Arithmetic instructions and programs
S-10 to S-12	SLO-1	Verification of truth tables using logic gates	Design of Half adder, Full adder, Half subtractor and Full subtractor using logic gates	Design of Shift left and Shift right registers	Assembly Language Programs to perform the Arithmetic operations (multiplication and division) using microprocessor 8085.	Assembly Language Programs to perform the Arithmetic operations (multiplication and division) using microcontroller 8051
	SLO-2					
S-13	SLO-1	Basic and derived logic gates– Symbols and their truth tables– AND–OR–NOT	Full subtractor	Ring Counter	Arithmetic and logical instructions	Logical instructions and programs
	SLO-2	Basic and derived logic gates– Symbols and their truth tables– AND–OR–NOT	Two's complement adder circuits	Twisted Ring counter	Details of arithmetic and logical instructions	Logical instructions and programs
S-14	SLO-1	Basic and derived logic gates– Symbols and their truth tables– AND–OR–NOT	Two's complement substractor circuits	Synchronous and Asynchronous counter	Branch instructions	Jump, Loop and Call instructions and programs
	SLO-2	NAND– NOR logic gates	Binary Coded Decimal (BCD) adder	Synchronous and Asynchronous counter	Details of branch instructions	Jump, Loop and Call instructions and programs
S-15	SLO-1	XOR– XNOR logic gates	Encoder and Decoder	Binary up-down counter.	Simple programs	Simple programs
	SLO-2	NAND-NOR GATE as a Universal logic gate	Multiplexer and Demultiplexer	Mod N counter	Simple programs	Simple programs
S-16 to S-18	SLO-1	NAND and NOR gates as Universal logic gates	Design of decade counter and count table verification	Design of Synchronous and Asynchronous Counter	Programs to perform the Arithmetic operations (Solving expressions) using microprocessor 8085.	Assembly Language Programs to perform the Arithmetic operations (Solving expressions) using microcontroller 8051
	SLO-2					

Learning Resources	1. Electronic Devices (Conventional Current Version), by T. L. Floyd, Pearson, 10th Edition, (2017). 2. Ramesh S. Gaonkar, Microprocessor Architecture, Programming and Applications with 8085, New Age International 6 th edition, 2013 3. Kenneth J. Ayala, The 8051 Microcontroller Architecture, Programming and Applications. Penram International publishing Pvt. Ltd., second edition, 2000.	4. Electronic Principles, by A. P. Malvino, D. J. Bates, McGraw-Hill, 8th Edition, (2015) 5. R.P.Jain, Modern Digital Electronics, Tata McGraw Hill, 2006. 6. Douglas V., Microprocessors and Interfacing-Programming and Hardware, Hall, Tata McGraw Hill, 1993. 7. Muhammad Ali Mazidi and Janice Mazidi, The 8051 Microcontroller and Embedded systems,Pearson Education, 2000.

Learning Assessment

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

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

Course Designers

Experts from Industry	Expert from Higher Technical Institutions	Internal Experts
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Dr. V. Jayaraman, IGCAR, Kalpakkam, vjram@igcar.gov.in	*Dr. V Gunasekaran, Central University TN, gunasekaran@cutn.ac.in*	*Dr. Naga Rajesh, SRMIST*

Course Code	UPY23D01J	Course Name	Sensors and Detectors	Course Category	D	Discipline-Specific Elective Courses	L	T	P	O	C
							3	0	2	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:*
CLR-1 :	*know about the principle, and working of sensors*
CLR-2 :	*understand the types of sensors and the corresponding physical effects*
CLR-3 :	*comprehend the knowledge on physical sensors*
CLR-4 :	*realize the importance of chemical sensors*
CLR-5 :	*learn about particle sensors*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning: Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	PLO 1: Fundamental Knowledge	PLO 2: Application of Concepts	PLO 3: Link with Related	PLO 4: Procedural Knowledge	PLO 5: Skills in Specialization	PLO 6: Ability to Utilize Knowledge	PLO 7: Skills in Modeling	PLO 8: Analyze, Interpret Data	PLO 9: Investigative Skills	PLO 10: Problem Solving Skills	PLO 11: Communication Skills	PLO 12: Analytical Skills	PLO 13: PSO -1	PLO 14: PSO -2	PLO 15: PSO-3
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	understand the principles of sensors	2	75	60	H	H	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-2 :	distinguish different types of sensors	2	80	70	H	H	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-3 :	elaborate about the physical sensors	2	70	65	H	H	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-4 :	recognize the importance of chemical sensors	2	70	70	H	H	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-5 :	admire the particle sensors and its application apart from particle physics	2	80	70	H	H	-	-	-	-	-	-	-	-	-	H	-	-	-

Duration (hour)		15	15	15	15	15
S-1	SLO-1	Introduction to Sensors	Introduction to physical sensors	Introduction to chemical sensors	On-board automobile sensors-Flow-rate sensors-Pressure sensors-Temperature sensors	Particle detector - introduction, Interactions of charged particles
	SLO-2	Active and passive sensors	temperature sensors	Thermal sensors – principle, working	Oxygen sensors-Torque and position sensors	Interactions of photons
S-2	SLO-1	Static characteristics	Sensors for aerospace and defense	Types of thermochemical sensors	Home appliance sensors-mechanical category	Characteristic properties of detectors
	SLO-2	Accuracy and precision	Accelerometer	Mass sensors- principle, working	Chemical, temperature and radiation sensors in home appliances	Units of radiation measurements and radiation sources
S-3	SLO-1	Offset and linearity	Pressure sensor	SAW and quartz crystal microbalance	Aerospace sensors- Static pressure sensors	Ionization counters, Scintillation counters
	SLO-2	Dynamic characteristics	Types of pressure sensors and application	Electrochemical sensors-principle, working	Temperature sensing	Photomultipliers and photodiodes
S-4 to S-5	SLO-1	Precision and accuracy demonstratin using weighing scale	Demonstration of pressure gauge	Thermal sensor demonstration	gas sensor demonstration	Particle detector videos
	SLO-2					
S-6	SLO-1	Zeroth order sensors	Strain sensors	Types of electrochemical sensors	Fluid velocity sensors	Historical Track detectors
	SLO-2	First Order sensors	Flow rate sensors,	Potentiometric sensors-principle, working	Monitoring strain, force, thrust and acceleration	Cloud chambers, Bubble chambers
S-7	SLO-1	Second order sensors	Speed sensors	Amperometric sensors-principle, working	Medical diagnostic sensors – radiation, biomechanics, temperature	X-ray films
	SLO-2	Physical effects involved in signal transduction	Optical sensors	Conductometric sensors-principle, working	Electromagnetic variables	Silver-halide crystals
S-8	SLO-1	Photoelectric effect	Mechanical sensors	Optical chemical sensors-principle, working	Chemical and electrochemical sensors	Track detectors - Semiconductor track detectors
	SLO-2	Photoluminescence effect	Anisotropic Magneto-Resistive (AMR) sensors	Types of optical chemical sensors	Variables related to blood flow-Kinematic and geometric	Scintillating fibre trackers
	SLO-1					Bubble chamber (virtual tour)

S-9 to S10	**SLO-2**	Vides on working of Photovoltaic cell	Speed sensors demonstration	Optical sensor demonstration	Geiger Muller counter demonstration	
S-11	**SLO-1**	Electroluminescence effect	Giant magneto resistance effect	Fiber optic chemical sensors- principle, working	Sensors for food monitoring- introduction	Calorimetry - Electromagnetic calorimeters
	SLO-2	Hall effect	Colossal magneto resistance effect	Types of Fiber optic chemical sensors	Types of sensors for food monitoring	Cryogenic calorimeters
S-12	**SLO-1**	Thermoelectric effect	Extraordinary magneto resistance effect	Sensitivity	Sensors for environmental monitoring	Charged-particle identification
	SLO-2	Piezoresistive effect	Tunneling magneto resistance effect	Selectivity	Pollution hazards	Particle identification with calorimeters
S-13	**SLO-1**	Piezoelectric effect	GMR, TMR based sensors	Sensor arrays -Electronic nose	Sensing environment pollution	Applications of particle detectors outside particle physics - Medical
	SLO-2	Magneto resistive effect	Magnetic tunneling junctions	Electronic tongue	Ecological studies of air	Applications of particle detectors outside particle physics - Astronomy
S-14 to S-15	**SLO-1**	Hall Effect Demonstration	Videos on GMR, TMR, MTJ	Videos on Electronic Noses and Tongues	Demonstration of sensor used in environmental pollution	Cryogenic calorimeter (virtual tour)
	SLO-2					

Learning Resources	1. Environmental Nanotechnology, by M. H. Fulekar, Bhawana Pathak 2. Lynn J. Frewer, Willehm Norde, R. H. Fischer and W. H. Kampers, Nanotechnology in the Agri-food sector, Wiley-VCH Verlag, (2011). 3. Jennifer Kuzma and Peter VerHage, Nanotechnology in agriculture and food production, Woodrow Wilson International Center, (2006)	4. P. J. Brown and K. Stevens, Nanofibers and Nanotechnology in Textiles, Woodhead Publishing Limited,Cambridge, (2007). 5. Neelina. H, Malsch (Ed.), "Biomedical Nanotechnology", CRC Press (2005). 6. Particle detectors, Claus Grupen, Boris Shwartz, Cambridge University Press, (2008) 7. Handbook of modern sensors: physics, designs, and applications, 3e (HB) by Jacob Fraden, Springer

Learning Assessment

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

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

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Course Code	UPY23D02J	Course Name	Biophysics	Course Category	D	Discipline-Specific Elective Courses	L	T	P	O	C
							3	0	2	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1:	*acquire knowledge on nucleic acid structure*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2:	*understand the basics of protein interactions*			
CLR-3:	*familiarize with protein structure*			
CLR-4:	*know about the fundamentals of bioinformatics*			
CLR-5:	*explore the different structure determination methods*			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning		
		1	2	3
CLO-1:	*apply skills to analyse the dna structure*	2	80	75
CLO-2:	*analyze the interaction between proteins*	2	80	70
CLO-3:	*predict the structure of proteins*	2	75	70
CLO-4:	*apply the concepts of bioinformatics in biophysics*	2	80	75
CLO-5:	*apply different structure prediction methods*	2	80	70

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

Duration (hour)		15	15	15	15	15
S-1	SLO-1	*Structural biology*	*Principles of ionization equilibrium ionization of side chain*	*Protein structure*	*Introduction to Bioinformatics and Computational Biology*	*Structure determination techniques*
	SLO-2	*Principles of nucleic acid structure*	*Equilibrium in proteins*	*Concept of rigid planar peptide unit*	*Biological sequences*	*Phase problem*
S-2	SLO-1	*Watson and Crick's base-pairings*	*Polypeptide chain geometrics*	*cis and trans configuration*	*Biological databases*	*Molecular replacement method*
	SLO-2	*Non Watson and Crick pairing schemes*	*estimates of potential energy*	*structural implication conformations of a pair of linked peptide units*	*Genome specific databases*	*Isomorphous replacement method*
S-3	SLO-1	*base stacking interactions*	*potential energy calculations*	*torsion angles phi and psi*	*Sequence Analysis*	*preparing heavy atom derivatives*
	SLO-2	*DNA polymorphism*	*hydrogen bonding*	*Steric hindrance*	*Multiple sequence alignment*	*Anomalous scattering*
S-4 to S-5	SLO-1	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2					
S-6	SLO-1	*structure of A-DNA*	*hydrobhobic interactions*	*hard sphere approximation*	*Algorithms for Multiple sequence alignment*	*Atomic scattering factor*
	SLO-2	*B-DNA*	*water as universal solvent in biological systems*	*allowed and disallowed conformations*	*Generating motifs and profiles*	*diffraction by a space lattice - structure factor equation*
S-7	SLO-1	*Z- DNA*	*Disruption of hydrophobic interactions by urea*	*Ramachandran Diagram*	*Local and Global alignment*	*Multiwave length anomalous dispersion technique*
	SLO-2	*helical transitions*	*ionic interactions*	*specific effects of proline and glyline*	*Needleman and Wunsch algorithm*	*Electron density maps*
S-8	SLO-1	*Non-uniform helical DNA Structure*	*hydrophobic versus ionic interactions*	*conformationally constrained amino acids and their importance.*	*Smith Waterman algorithm*	*Structure refinement*
	SLO-2	*Unusual DNA structures*	*Disulfide bond*	*primary, secondary, tertiary and quaternary structures*	*BLAST, PSIBLAST and PHIBLAST algorithms*	*the Rfactor - rigid body refinement with restraints*
S-9 to S-10	SLO-1	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2					
S-11	SLO-1	*hairpins*	*Ways of pairing N-half cystine*	*alpha helix, beta sheet, reverse turns*	*Protein Secondary structure and tertiary structure prediction methods*	*minimizing bias from the model*
	SLO-2	*bulges*	*formation of specific disulfide link*	*Super secondary structures- - alpha, beta and alpha*	*Homology modeling*	*rebuilding poor parts of a model*

S-12	**SLO-1**	*cruciform*	*prediction of protein structure*	*Structure of collagen*	*abinitio approaches*	*producing the final map and the model*
	SLO-2	*Triplexes, tetraplexes*	*Two state model of protein stability*	*Structure and action of myoglobin*	*Threading*	*Accuracy of the final model*
S-13	**SLO-1**	*Structure of tRNA*	*chemical denaturation and stabilization*	*protein structure perdiction*	*Structure Prediction*	*Ramachandran map*
	SLO-2	*hydration of nucleic acids*	*surface denaturation*	*Protein folding mechanisms*	*Molecular docking principles and applications*	*tools for structure analysis*
S-14 to S-15	**SLO-1**	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2					

Learning Resources	*1.* Principles of Protein Structure, by Georg E. Schulz and R. Heiner Schirmer *2.* Introduction to Protein Structure, by Carl-Ivar Brändén and John Tooze *3.* Principles of Nucleic Acid Structure, by Wolfram Saenger. *4.* Vasantha Pattabhai and N. Gautham Biophysics (2002) Narosa Publishers ISBN 1- 4020-0218-1	*5.* Biophysical Chemistry of Nucleic Acids and Proteins, Thomas E. Creighton 2010 *6.* Introduction to Bioinformatics by Arthur K. Lesk, Oxford University Press. ,4 th edition 2014 *7.* Crystallography Made Crystal Clear: A Guide for Users of Macromolecular Models, 2006 by Gale Rhodes, Academic Press; 3 edition

Learning Assessment

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

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

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Dr. Dr. Arun Babu, Realgae Biopharma solutions, Chennai	Dr. T. Prakash, UOM	Dr. G. Devanand Venkatasubbu, SRM IST
Dr. K. Chandru, HCL Medical devices, Chennai	Dr. Dr.J.Kalyana Sundar, Periyar University	Dr. P. Sivakumar, SRM IST

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

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	Acquire basic knowledge on estimation of solar radiation at the earth's surface
CLR-2:	Familiarize with the principles of thermal energy collection and storage
CLR-3:	Understand the physics of pn junction solar cell
CLR-4:	Know about various PV materials and their importance in solar cell technology
CLR-5:	Familiarize with various concepts of solar photovoltaic system design and installation

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning: Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	PLO 1 Fundamental Knowledge	PLO 2 Application of Concepts	PLO 3 Link with Related	PLO 4 Procedural Knowledge	PLO 5 Skills in Specialization	PLO 6 Ability to Utilize	PLO 7 Skills in Modeling	PLO 8 Analyze, Interpret Data	PLO 9 Investigative Skills	PLO 10 Problem Solving Skills	PLO 11 Communication Skills	PLO 12 Analytical Skills	PSO - 1	PSO - 2	PSO - 3
CLO-1:	*Know about the present energy scenario and the potential of solar energy option for future energy*	2	80	75	H	-	-	-	-	-	-	-	-	H	-	H	-	-	-
CLO-2:	*Have a knowledge of the solar thermal collectors and the need for thermal energy storage*	2	80	70	H	-	H	-	-		-	-	-	H	-	-	-	-	-
CLO-3:	*Gain a fundamental understanding of solar photovoltaics*	2	75	70	H		H	-	-	H	-	-	-	-	-	-	-	-	-
CLO-4:	*Apply various concepts to describe how electricity is produced and utilized with commercially available solar panels*	2	80	75	-	H	-	-	H		-	-	-	H	-	-	-	-	-
CLO-5:	*Differentiate between solar thermal and solar photovoltaic technologies and their applications*	2	80	75	-	H	-	-	-	-	-	H	-	H	-		-	-	-

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

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

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

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

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

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Course Code	UCY23G02T	Course Name	Polymer chemistry and its uses	Course Category	G	Generic Elective Course	L	T	P	O	C
							3	1	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
CLR-1:	Exposure to polymers and their chemistry	
CLR-2 :	Get knowledge on synthesis, properties and applications of different kinds of polymers	
CLR-3 :	Learn this course will develop skills on synthesis of conducting polymers and understand the significance and applications of conducting polymers	
CLR-4 :	Enrich the knowledge on biopolymers and biodegradable polymers and the basic aspects of polymer nanocomposites	
CLR-5 :	Knowledge on materials developed with polymers and their applications in today's on demand applications	

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

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Introduction to polymer	Introduction to LCPs	Synthesis of bioionic polymers (example 1)	polyaromatic conducting polymers: synthesis	Use of polymer for designing drug carriers
	SLO-2	Use	Use	Synthesis of bioionic polymers (example 1)	Examples	controlled drug release
S-2	SLO-1	Step-growth polymerization mechanism	Application of LC main-chain polymers (example 1)	Applications of bioionic polymers (example 1)	Polyaniline, polypyrrole & polythiophene	pH-responsive polymers
	SLO-2	example	Application of LC main-chain polymers (example 2)	Applications of bioionic polymers (example 2)	Use	Application
S-3	SLO-1	Radical chain polymerization: mechanism	Side-chain LC polymers (example 1)	Ionic crosslinking and ion exchange	Poly(3,4- ethylenedioxythiophene) (PEDOT)	Photoresponsive polymers
	SLO-2	Example	Side-chain LC polymers (example 2)	Use	poly(p-phenylene sulfide), poly(vinyl carbazole)	Application
S-4	SLO-1	Tutorial session	Tutorial session	Tutorial session	Tutorial session	Tutorial session
	SLO-2					
S-5	SLO-1	Ionic chain polymerization: mechanism	Properties of side- chain LC polymers	Ionomers based on polyethylene	Applications of conducting polymers: polymer rechargeable batteries	Magnetically responsive polymers
	SLO-2	Examples	Applications	Polystyrene	Examples	enzyme responsive polymers
S-6	SLO-1	Chain Copolymerization: mechanism	Photochromic LCPs	Polyelectrolytic complexes	Applications of conducting polymers: polymer: sensors/biosensor	Shape memory polymers
	SLO-2	Examples	chiral-photochromic LCPs	Applications	Examples	Applications
S-7	SLO-1	Ring opening polymerization: mechanism	LC block copolymers	Inorganic ionic polymers (synthesis)	Electrochemical actuators	Smart hydrogels
	SLO-2	Examples	Use	Applications	Examples	Applications

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

Learning Resources

Theory:
1. A. R. West, Basic Solid State Chemistry, 2nd Ed., John Wiley &Sons Ltd., 1999.
2. K. J. Klabunde, Nanoscale materials in Chemistry, Wiley Interscience, New York, 2001.
3. C. Giacovazzo, Fundamentals of Crystallography, Oxford University Press, 2002.
4. W. D. Callister and D. G. Rethwisch, Materials Science and Engineering: An Introduction,9th Ed., Wiley, 2013.
5. D. J. Ward, Materials Science, Lerner Classroom, 2008.
6. W Wagner, S Sakiyama-Elbert, G Zhang, M Yaszemski. Biomaterials Science: An Introduction to Materials in Medicine, 4th Ed., Academic Press, 2020.

Learning Assessment

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

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

Course Designers

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

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Course Code	UPY23S03L	Course Name	Microprocessors and Microcontrollers	Course Category	S	Skill Enhancement Course	L	T	P	O	C
							0	0	2	2	1

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	*understand the architecture of microprocessor and application*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*acquire knowledge about the microprocessors and the organization of microprocessor-based systems*			
CLR-3 :	*acquire 8085 microprocessor programming skills*			
CLR-4 :	*understand the architecture of 8051 microcontroller*			
CLR-5 :	*acquire 8051 microcontroller programming skills and understand interfacing 8085 microprocessor with peripherals*			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*understand the basic arithmetic instructions in 8085 microprocessor and 8051 microcontroller.*	3	80	85	H	H	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-2 :	*impart knowledge about data transfer schemes in 8085 microprocessor and 8051 microcontroller.*	1	75	80	H	H	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-3 :	*understand the basic logical instructions in 8085 microprocessor and 8051 microcontroller.*	3	85	80	H	H	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-4 :	*implementation of mathematical formulae through instructions*	3	80	75	H	H	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-5 :	*able to program 8085 microprocessor and 8051 microcontroller and develop interfacing skills in 8085 microprocessor*	1	75	85	H	H	-	-	-	-	-	-	-	-	-	H	-	-	-

DURATION (HOURS)		6	6	6	6	6
S1 to S2	SLO-1	*Introduction to Assembly Language Programming-*	*Perform Block transfer of data from one set of memory locations to another set of memory location using 8085 microprocessors*	*Decimal counter using microprocessor 8085.*	*Perform the Arithmetic operations (addition and Subtraction, multiplication and division) using microcontroller 8051*	*Temperature conversion using microcontroller 8051.*
	SLO-2					
S3 to S4	SLO-1	*Perform the Arithmetic operations (addition and Subtraction, multiplication and division) using microprocessor 8085.*	*Code conversion using microprocessor 8085.*	*Biggest and Smallest Numbers using microprocessor 8085.*	*Perform the Logical operation using microcontroller 8051*	*Decimal counter using microcontroller 8051.*
	SLO-2					
S5 to S6	SLO-1	*Perform the Logical operation using microprocessor 8085.*	*Temperature conversion using microprocessor 8085.*	*Ascending and Descending Order using microprocessor 8085*	*Code conversion using microcontroller 8051.*	*Repeat/Revision of experiment*
	SLO-2					

Learning Resources

1. Micro Processor Architecture, Programming & Applications with the 8085, Ramesh S Goankar (6th Edition, Penram International Publishing (India) Pvt. Ltd., 2011).
2. The 8051 Microcontroller, Kenneth J. Ayala, (3rd Edition, Publisher Cengage Learning, 2007).
3. Fundamentals of Digital electronics and Microprocessors, Anokh Singh, A.K. Chhabra,(S.Chand, 2011).
4. The 8051 Microcontroller and Embedded Systems, Mazidi, (2nd Edition, Publisher Pearson, Education India, 2007).
5. Microprocessors and Microcontrollers, Kumar, N. Senthil, Saravanan M., and Jeevananthan S., (Oxford University Press, Inc., 2011)

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 / Understand	-	30 %	-	30 %	-	30 %	-	30 %
Level 2	Apply / Analyze	-	40 %	-	40 %	-	40 %	-	40 %
Level 3	Evaluate / Create	-	30 %	-	30 %	-	30 %	-	30 %
	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 Industry	Experts from Higher Technical Institutions	Internal Experts
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Course Code	UPY23P02L	Course Name	Internship - II	Course Category	P	Internship/ Project	L	T	P	O	C
							0	0	0	0	1

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:
CLR-1:	*assist the student's professional skill development useful to employer such as teamwork, communications and work ethics & details*
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:
CLO-1:	*demonstrate the skill gained through work experience with mentors or successful professionals to support the early stages of their career*

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

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SEMESTER VI

Course Code	UPY23601J	Course Name	Electromagnetics and Applications	Course Category	C	Professional core course	L	T	P	O	C
							3	0	2	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:
CLR-1 :	develop theoretical knowledge in electrodynamics
CLR-2 :	develop skills on solving analytical problems in electrodynamics
CLR-3 :	bridge the gap between the fundamental principles taught in electromagnetism and its practical application
CLR-4 :	acquire advanced knowledge in current understanding of electrodynamics.
CLR-5 :	understand the electrodynamics of radiating and relativistic systems.

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning 1 Level of Thinking (Bloom)	Learning 2 Expected Proficiency (%)	Learning 3 Expected Attainment (%)	PLO 1 Fundamental Knowledge	PLO 2 Application of Concepts	PLO 3 Link with Related Disciplines	PLO 4 Procedural Knowledge	PLO 5 Skills in Specialization	PLO 6 Ability to Utilize Knowledge	PLO 7 Skills in Modeling	PLO 8 Analyze, Interpret Data	PLO 9 Investigative Skills	PLO 10 Problem Solving Skills	PLO 11 Communication Skills	PLO 12 Analytical Skills	PLO 13 PSO -1	PLO 14 PSO -2	PLO 15 PSO-3
CLO-1 :	be familiar with some elementary phenomena and concepts in electrodynamics	2	75	60	H	-	-	-	-	-	-	-	-	M	-	H	-	-	-
CLO-2 :	master the technique of deriving and evaluating formulae for the electromagnetic fields at an interface	2	80	70	H	-	-	-	-	-	-	-	-	M	-	H	-	-	-
CLO-3 :	formulate the guided waves in a waveguide	2	70	65	H	-	-	-	-	-	-	-	-	M	-	H	-	-	-
CLO-4 :	understand light propagation in a fibre	2	70	70	H	-	-	-	-	-	-	-	-	M	-	H	-	-	-
CLO-5 :	calculate the electromagnetic radiation from radiating systems	2	80	70	H	-	-	-	-	-	-	-	-	M	-	H	-	-	-

Duration (hour)		15	15	15	15	15
S-1	SLO-1	Review of Maxwell's equations	Polarization by reflection (Brewster's angle)	Introduction to waveguides	Waveguide resonators	Retarded potentials
	SLO-2	Poynting's theorem and Poynting vector	Goos-Hanchen effect (qualitative)	Rectangular waveguides	TM mode	Retarded potentials
S-2	SLO-1	Maxwell's equations in matter	Electromagnetic waves in conductors	Solving wave equation to obtain the conditions for different modes	Resonant frequency for TM mode	Advanced potentials
	SLO-2	Polarization current	Skin depth	transverse electromagnetic mode	TE mode	Lienard-Wiechert potentials
S-3	SLO-1	Boundary conditions (qualitatively)	Reflection at a conducting surface	TE modes	TE mode	Lienard-Wiechert potentials
	SLO-2	Momentum	Reflection at a conducting surface	TM modes	Quality factor,	Radiation
S-4 to S-5	SLO-1	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars
	SLO-2					
S-6	SLO-1	Maxwell's stress Tensor	Frequency dependence of permittivity	Cut off angular frequency for TM mode	Optical fiber	Electric dipole radiation
	SLO-2	Maxwell's stress Tensor	Electron oscillator model	Cut off angular frequency for TM mode	Advantages of optical fiber over copper technology	Electric dipole radiation
S-7	SLO-1	Conservation of momentum	Complex dielectric constant	Evanescent condition for TM mode	Numerical aperture	Radiation zone
	SLO-2	Angular momentum	Absorption coefficient	Propagation condition TM mode	Numerical aperture	Energy radiated by an oscillating electric dipole
S-8	SLO-1	Plane electromagnetic waves, Linear and circular polarization	Anomalous dispersion	Phase velocity	Attenuation,	Total power radiated by an oscillating dipole
	SLO-2	Stokes parameters	Cauchy's formula	Wave impedance of the mode	Dispersion	Magnetic dipole radiation
S-9 to S-10	SLO-1	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars
	SLO-2					

S-11	SLO-1	*Stokes parameters*	*Low frequency behavior, Electric conductivity*	*Field configuration of TM mode*	*The Potential Formulation*	*Magnetic dipole radiation*
	SLO-2	*Electromagnetic wave propagation in linear media, index of refraction*	*Low frequency behavior, Electric conductivity*	*TM modes (qualitatively)*	*Scalar and Vector potentials*	*Far field approximation and comparison with Electric dipole power*
S-12	SLO-1	*Reflection and Transmission at Normal incidence*	*High frequency limit, Plasma frequency*	*Comparison between TE and TM modes*	*Gauge transformations*	*Power radiated by a point charge:*
	SLO-2	*Reflection and Transmission at Normal incidence*	*High frequency limit, Plasma frequency*	*Wave propagation in the guide*	*Coulomb gauge*	*Larmor formula, Lienard's relativistic generalization*
S-13	SLO-1	*Reflection and Transmission at oblique incidence, Fresnel equations*	*Evanescent fields*	*Power transmission and transmission (qualitatively)*	*Lorentz gauge*	*Radiation reaction (qualitatively)*
	SLO-2	*Fresnel's equations*	*Energy transport by evanescent fields, Frustrated total internal reflection*	*Power transmission and transmission (qualitatively)*	*Lorentz gauge*	*Abraham-Lorentz formula (qualitatively)*
S-14 to S-15	SLO-1 SLO-2	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*

Learning Resources	1. D.J. Griffiths, Introduction to Electrodynamics, 4th Ed., Prentice-Hall India, 2013. 2. M. N. O. Sadiku, Elements of Electromagnetics, Oxford University Press, 2018 3. 3. E.C. Jordan, and K. G. Balmain, Electromagnetic Waves and Radiating Systems, Prentice Hall, 1995.	4. J.D. Jackson, Classical Electrodynamics, 3rd Ed., Wiley 1998. 5. Schwinger et. al., Classical Electrodynamics, Persesus Books, 1998. 6. G.S. Smith, Classical Electromagnetic Radiation, Cambridge, 1997.

Learning Assessment

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

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

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Dr. DK Aswal , NPL, dkaswal@nplindia.org	Prof. C Vijayan, IIT Madras, cvijayan@iitm.ac.in	*Dr. Rohit Dhir, SRMIST*

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Course Code	UPY23602J	Course Name	Atomic and Molecular Spectroscopy	Course Category	C	*Professional Core Course*	L	T	P	O	C
							3	0	2	2	4

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	Acquire knowledge about hydrogen atom models
CLR-2 :	Acquire in depth knowledge of structure of multi-electron atom
CLR-3 :	Understand the theory of X-ray Spectroscopy
CLR-4 :	Gain Knowledge about UV-Visible and microwave Spectra
CLR-5 :	Understanding of Infrared and Raman Spectroscopy

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	**Learning**			**Program Learning Outcomes (PLO)**														
		1	**2**	**3**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	Apply skills to solve advanced problems of Atomic structure	*2*	*75*	*60*	H	M	-	-	-	-	-	-	-	H	-	-	-	-	-
CLO-2 :	Analyze the effect of magnetic field on Atomic spectroscopy	*2*	*80*	*70*	H	M	-	-	-	-	-	-	-	H	-	-	-	-	-
CLO-3 :	Analyze X-ray spectroscopy for the understanding of the atoms	*2*	*70*	*65*	H	M	-	-	-	-	-	-	-	H	-	-	-	-	-
CLO-4 :	Apply molecular spectroscopy for characterization of materials	*2*	*70*	*70*	H	M	-	-	-	-	-	-	-	H	-	-	-	-	-
CLO-5 :	Apply acquired knowledge to solve structural properties using IR and Raman Spectroscopy	*2*	*80*	*70*	H	M	-	-	-	-	-	-	-	H	-	-	-	-	-

Duration (hour)		**15**	**15**	**15**	**15**	**15**
S-1	**SLO-1**	*Introduction*	*Orbital Magnetic dipole moment*	*Two particle system*	*Characterization of electromagnetic radiation*	*Infrared spectroscopy – vibrating diatomic molecule*
	SLO-2	*Early models of the atom*	*Magnetic dipole in uniform magnetic field*	*Symmetric And Antisymmetric Wave Functions, Slater determinants*	*Regions of the electromagnetic spectrum*	*Simple harmonic oscillator*
S-2	**SLO-1**	*Thomson's experiment and model*	*Stern-Gerlach experiment*	*Bosons and Fermions, Exchange operator*	*Mechanism for interaction between radiation and matter*	*Anharmonic oscillator*
	SLO-2	*Rutherford's experiment*	*Electron spin/ quantum numbers s and m_s.*	*Pauli's exclusion principle*	*Width of spectral lines*	*Fundamental absorption and first, second overtones*
S-3	**SLO-1**	*Rutherford model*	*Normal Zeeman Effect*	*Electron configuration, Periodic table*	*Intensity of spectral lines*	*Diatomic vibrating rotator*
	SLO-2	*Bohr's postulates*	*Energy splitting in Zeeman effect*	*Spectroscopic notation*	*Beer-Lambert law*	*Vibration rotation spectrum of CO*
S-4 to 5	**SLO-1**	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2					
S-6	**SLO-1**	*Bohr's model of the atom*	*Spin-orbit interaction*	*X-ray Production*	*Molecular Bond formation*	*Vibrations of polyatomic molecules*
	SLO-2	*Atomic spectra*	*Spin-Orbit Interaction Energy*	*Properties of X-rays*	*Hydrogen Molecule*	*Normal modes of vibration*
S-7	**SLO-1**	*Energy levels of hydrogen atom*	*Total Angular Momentum*	*Continuous X-rays*	*Optical Absorption*	*The water molecule (H_2O)*
	SLO-2	*Rydberg Formula and Hydrogen spectral series*	*LS-coupling*	*Duane-Hunt's law*	*UV-Visible spectroscopy*	*Modes of vibrations of H_2O molecule*
S-8	**SLO-1**	*Effect of nuclear mass on the wavelengths of spectral lines*	*jj-coupling*	*Characteristic X-ray*	*Electronic spectra (UV-Vis) for diatomic molecules*	*Raman scattering vs Rayleigh scattering*
	SLO-2	*Bohr's correspondence principle*	*Quantum numbers*	*Moseley's law*	*Advantages & Applications of UV-Vis Spectroscopy*	*Raman effect*
S-9 to S-10	**SLO-1**	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2					
S- 11	**SLO-1**	*Atomic Excitation*	*The idea of Hartree-Fock equations*	*Photoelectron Spectroscopy*	*Microwave spectroscopy - Rotation of molecules - classification*	*Quantum theory of Raman effect*

	SLO-2	*Franck-Hertz Experiment*	*Properties of the Hartree-Fock potential and spin orbitals*	*Auger effect*	*Rotational spectra of rigid diatomic molecule*	*Polarizability ellipsoids of molecules*
S-12	**SLO-1**	*Sommerfeld's model*	*Helium spectra*	*Compton Effect*	*Selection rules and allowed transitions between rotational energy levels*	*Classical theory of Raman effect*
	SLO-2	*Interpretation of Sommerfeld's theory*	*Difference between hydrogen and helium spectra*	*Physical Interpretation of Compton Effect*	*Intensities of spectral lines of rigid diatomic molecule*	*Rule for Raman activity*
S-13	**SLO-1**	*Sommerfeld's relativistic theory*	*Two-electron atoms*	*Derivation of expression for change in wavelength*	*Expression for J quantum number with max. population*	*Vibrational Raman spectra*
	SLO-2	*Fine Structure of Hydrogen Atom*	*Alkaline metal spectra*	*Experimental verification*	*Effect of isotopic substitution*	*Rotational Raman spectra of linear molecules*
S-14 to S-15	**SLO-1**	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2					

Learning Resources	1. *Concepts of Modern Physics by Beiser A, (6th Edition Mc–Graw Hill, 2009)* 2. *Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles by Robert Eisberg, Robert Resnick, (2nd Edition, Wiley, 2006)*	3. Fundamentals of Molecular Spectroscopy by Banwell C N and McCash E M (Tata McGraw-Hill, 2008)

Learning Assessment

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

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

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Mr. R Seshadri, Titan Company Limited, seshadri@titan.co.in	Prof. C Vijayan, IIT Madras, cvijayan@iitm.ac.in	*Dr. P. Sivakumar, SRMIST*

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Course Code	UPY23603T	Course Name	Research Methodology	Course Category	C	Professional Core Course	L	T	P	O	C
							4	0	0	2	4

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

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

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	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:	Differentiate between various kinds of academic writings	4	-	-	-	-	H	-	H	-	-	-	-	-	-	-	-
CLO-2:	Practice the basic skills of performing a quality literature review.	4	-	-	-	-	H	-	-	H	-	-	-	-	-	-	-
CLO-3:	Target the research work to a suitable journal and communicate for publication	4	-	-	-	-	-	H	-	-	H	-	-	H	-	-	-
CLO-4:	Develop competence in data collection and process of scientific	4	-	-	-	H	-	-	-	H	H	-	-	-	-	-	-
CLO-5:	Identify and avoid the plagiarism	4	-	-	-	-	-	-	H	-	H	-	-	-	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Objectives of research	Academic & research writing:	Basic statistical distribution-applications	Modelling skills	Ethics in research - authors
	SLO-2	Introduction about research	Introduction	Basic statistical distribution applications continued	Static Model	Acknowledgement
S-2	SLO-1	types of research-Descriptive vs analytical	Basic Rules of academic writing	Sampling: Concepts of Statistical Population	Dynamic Model	Group discussion on ethics in research
	SLO-2	types of research -applied vs fundamental	Usage of language in academic writing	Sample, Sampling Frame	Limitations	The outcome of group discussion
S-3	SLO-1	types of research- quantitative vs qualitative	Types of academic writing	Sampling Error	Optimization studies	Ethical issues
	SLO-2	types of research- conceptual vs empirical	Descriptive	Sample Size	Maxima & Minima, Conditions of Optimality	Ethical committee (Human and animal)
S-4	SLO-1	Research methods and methodologies- Description	Analytical	Probability Sample	Linear Programming Problem (LPP) - explantion	Plagiarism
	SLO-2	Research methods and methodologies –Explanation	Persuasive and critical	Simple Random Sample	Linear Programming Problem (LPP) – graphical application	Tools to avoid plagiarism
S-5	SLO-1	Activity on research methods	Activity - academic writing	Activity – Sampling	Activity – Modelling skills	Activity – Report writing and plagiarism check
	SLO-2	Activity on research methods	Activity - academic writing	Activity- Sampling	Activity – Modelling skills	Activity – Report writing and plagiarism check
S-6	SLO-1	Literature review: Introduction	Academic quality measurement tools - significance	Systematic Sample	Data Preparation	Introducing about Project Proposal funding agencies
	SLO-2	Source of literature	Citation indices	Stratified Random Sample	Data Preparation-methods	Introducing about Project Proposal funding agencies (Group Discussion)
S-7	SLO-1	Process of literature review	Principles underlying - impact factor: SNIP, SJR	Multi-stage sampling	Data collection – Maintaining a laboratory record	Intellectual property
	SLO-2	Online literature databases	h-Index, i10 Index and Journal Citation Reports (JCR)	Multi-stage sampling-continued	Tabulation and generation of graphs	Intellectual property rights

Duration (hour)		12	12	12	12	12
S-8	SLO-1	Literature management tools – Introduction	Basic statistical distribution	Determining size of the sample - methods	Data Analysis:	Copy rights
	SLO-2	Literature management tools - Explanation	Binomial distribution	Determining size of the sample - application	Data Analysis: methods	Patent rights
S-9	SLO-1	Consolidation of Literature-review	Poisson distribution	Practical considerations in sampling and sample size	Univariate analysis: frequency tables	COPE guidelines
	SLO-2	Sample - Consolidated Literature-review	Normal distribution	Practical considerations in sampling and sample size	Univariate analysis: bar charts	Patent law
S-10	SLO-1	Review Paper Writing.	Exponential distribution	Sample test	Univariate analysis: pie charts,	commercialization
	SLO-2	Review Paper Writing -Need	Geometric distribution	Student –t –test,	Univariate analysis: percentages	royalty
S-11	SLO-1	Review Paper Writing – method of writing	Weibull distribution	Student-F- test	Bivariate analysis- Cross tabulations	trade related aspects of intellectual property rights (TRIPS)
	SLO-2	Review Paper Writing – Outcome of review papers	Problem - solving with statistical tools	χ^2-test	Bivariate analysis- Chi-square test including testing hypothesis of association	Group discussion: IPR
S-12	SLO-1	Practicing - Review Paper Writing	Practicing – Statistical distribution	Practicing – Sample test	Practicing – Data preparation and analysis	Group Discussion on Copy rights
	SLO-2	Practicing - Review Paper Writing	Practicing – Statistical distribution	Practicing – Sample test	Practicing – Data preparation and analysis	Group Discussion on AI tools dedicated for research

Learning Resources

Theory:

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

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	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*
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Course Code	UPY23D03J	Course Name	Physics of Nanomaterials	Course Category	D	Discipline Specific Elective Course	L	T	P	O	C
							3	0	2	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Acquire knowledge on dimensionality and size dependent properties
CLR-2 :	Understand on different types of nanomaterials
CLR-3 :	Understand the techniques and their requirements for preparing nanomaterials.
CLR-4 :	Gain knowledge on nanomaterial characterization techniques
CLR-5 :	Acquire knowledge on the applications of nanomaterials

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning: Level of Thinking (Bloom)	Learning: Expected Proficiency (%)	Learning: Expected Attainment (%)	PLO 1 Fundamental Knowledge	PLO 2 Application of Concepts	PLO 3 Link with Related	PLO 4 Procedural Knowledge	PLO 5 Skills in Specialization	PLO 6 Ability to Utilize Knowledge	PLO 7 Skills in Modeling	PLO 8 Analyze, Interpret Data	PLO 9 Investigative Skills	PLO 10 Problem Solving Skills	PLO 11 Communication Skills	PLO 12 Analytical Skills	PSO 1	PSO 2	PSO 3
CLO-1 :	Explicate the size dependent behavior of nanomaterials	2	75	60	H	H	-	-	-	-	-	-	H	-	-	-	-	-	-
CLO-2 :	Analyze the properties of various nanomaterial	2	80	70	H	-	-	H	-	-	-	M	-	M	-	-	-	-	-
CLO-3 :	Utilize the suitable nanomaterial for a particular application	2	70	65	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Implement a suitable technique to study the nanomaterial	2	70	70	H	-	-	H	-	-	-	M	-	M	-	-	-	-	-
CLO-5 :	Illustrate the methods of preparation characterization techniques of nanomaterials	2	80	70	H	H	-	-	M	-	-	-	-	-	-	-	-	-	-

Duration (hour)		15	15	15	15	15
S-1	SLO-1	Introduction about nanoscale materials	Important factors to understand change in properties	Change in properties-important principle factors	Change in properties-important principle factors	Change in properties-important principle factors
	SLO-2	Significance of nanoscale materials	Quantum confinement, Quantum confinement an Bohr exciton radius	Bottom-up approach	Optical absorption an spectroscopy	Advantages of using nanoparticles as a drug delivery system
S-2	SLO-1	Dimensionality	Effect of confinement	Lithography – Basic Concept	Beer's law and Lambert law	Storage devices and nanomaterial
	SLO-2	Difference between bulk and nanoscale materials	Quantization effect on electronic state	Types of Lithography	Interaction of EMR with matter	Battery and electrical energy storage
S-3	SLO-1	Classification nanomaterial based on dimensionality	Electronic state transition from bulk metal/semiconductor to small cluster	Photolithography Roots and conditions	Electron transitions (bonding, antibonding)	Lithium-ion battery, Working principal of Li-ion battery
	SLO-2	Zero dimensional, one-dimensional, and two dimensional nanomaterials	Dimensionality and Optical Properties, Asymmetry plays a large role on optical properties	Steps Used in Photolithography, Types of Photoresist	Primary Photophysical process, Absorption and emission pathways	Discovery of Photocatalysis
S-4 to S-5	SLO-1	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars
	SLO-2					
S-6	SLO-1	Quantum dots with few examples	Change in color with size of nanoparticles	Contact, proximity and projection	Photoluminescence (PL)	Definition of Photocatalysis
	SLO-2	Properties of quantum dots	Optical Properties of Semiconductor	Resolution and depth of focus in Photolithography	Luminescent and phosphor	Photocatalytic Mechanism
S-7	SLO-1	Nanoribbons and its application	Dimension effect on electronic structure (DOS and band position)	Problems/Demos/ Simulations/Seminars: calculation of resolution and depth of focus	Decay processes and Jablonski energy diagram	Photocatalysis and semiconducting nanomaterials
	SLO-2	Graphene nanoribbons properties	Semiconductor size and red-shift in absorption	Photoresist cleaning and device fabrication	Properties of Luminescence spectrum	Oxidation mechanism and valence band position
S-8	SLO-1	Nanowires and its applications	Brus Equation	electron-beam lithography	Application of PL	Reduction Mechanism
	SLO-2	Density of states (DOS) and its importance	electron-hole spatial correlation effect and Brus equation modification	Procedures of EBL	Raman spectroscopy and basic principles	Application of Photocatalysis: self-cleaning

S-9 to S-10	**SLO-1**	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2					
S- 11	**SLO-1**	*Density of state for 1 dimensional nanomaterial*	*Optical Properties of Metal nanomaterial*	*Sol-Gel methods, Definition of sol and gel*	*X-ray Diffraction (XRD), Peak Broadening method for crystallite size estimation*	*Spin degree of freedom, spin field effect transistors (SPINFET)*
	SLO-2	*Density of state for 2-dimensional nanomaterial*	*Advantages of different color of metal nanoparticles*	*Colloidal gel and polymer gel, Sol stabilization*	*Use of XRD pattern*	*Advantages of Spin and GMR*
S-12	**SLO-1**	*Density of state for 3-dimensional nanomaterial*	*Surface plasmon resonance (SPR)*	*Step by step Sol-Gel process*	*Phase identification, Scherrer formula and grain size determination*	*Tunneling magnetoresistance (TMR)*
	SLO-2	*Density of state for zero-dimensional nanomaterial*	*Delocalized electron and oscillation of conduction electrons*	*Hydrolysis and condensation reaction*	*scanning electron microscope (SEM)*	*magnetic tunnel junction (MTJ)*
S-13	**SLO-1**	*Carbon nanotubes, Atomic structure of CNT, primitive unit cell*	*Understanding of polarization*	*Network formation and ageing during sol-gel process*	*transmission electron microscope (TEM),*	*magnetic tunnel junction (MTJ) and spin*
	SLO-2	*Types and structure of CNT, chiral vector and chiral angle representation in CNT*	*Surface area to volume ratio of bulk materials and nanomaterials*	*Hydrothermal synthesis, Solvothermal Synthesis*	*atomic force microscope (AFM)*	*Magnetic tunnel junction based devices*
S-14 to S-15	**SLO-1**	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2					

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

Learning Assessment

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

CLA – 4 can be from any combination of these: Assignments, Seminars, 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. M Krishna Surendra, Saint Gobain Research, krishana.muvvala@saint-gobain.com	Prof. S Balakumar, University of Madras, balakumar@unom.ac.in	*Dr. Bhaskar Behera, SRMIST*
Mr. Navneethakrishanan, CLR Laboratories Pvt Ltd.	Prof. C Venkateshwaran, University of Madras, venkateshwaran@unom.ac.in	*Dr. Arijith Sen, SRMIST*

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Course Code	UPY23D04J	Course Name	Astrophysics	Course Category	D	Discipline Specific Elective Course	L	T	P	O	C
							3	0	2	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1:	*Learn the fundamental knowledge about the astronomical units and geometrical coordinate of solar and planetary systems and related events*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2:	*Understand the laws, their utilization and classification of the sequences of the Staller objects*			
CLR-3:	*Understand the different components of the Solar System and its core structure*			
CLR-4:	*Interpret the concepts of Universe expansion and characteristics of the Galaxies in the universe*			
CLR-5:	*Define and interpret the observational properties of astronomical objects*			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1:	*Perceive the basics of astronomy and Astrophysics*	2	80	75
CLO-2:	*Account for the real facts and features of all astronomical object and events*	2	80	70
CLO-3:	*Relate the acquired knowledge to celestial objects*	2	75	70
CLO-4:	*Understand modern astronomy and Observations*	2	80	75
CLO-5:	*Recognize and analyze the problems in modern Astronomy and Astrophysics*	2	80	70

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

Duration (hour)		15	15	15	15	15
S-1	SLO-1	*History of astronomy*	*Stellar Parallax*	*The Sun, Our Star*	*Structure of the Solar System*	*A Universe of Galaxies*
	SLO-2	*Astronomical Numbers and Units*	*Method of determination*	*Various Properties*	*Components of the Solar System*	*Early Observations*
S-2	SLO-1	*Celestial Sphere*	*Magnitude scale: Brightness, Radiant Flux and Luminosity*	*Hydrostatic Equilibrium: Pressure Balance*	*Age of the Solar system*	*Distances of Galaxies*
	SLO-2	*Introduction to Astronomical and Geographical Coordinate Systems*	*The Period Luminosity (P-L) Relation*	*Sun's Interior*	*Formation of the planets: The Nebular Model*	*Standard Candles (Cepheids and SNe Type1a)*
S-3	SLO-1	*Horizon System*	*Determination of Temperature*	*Solar Atmosphere*	*The Terrestrial Planets*	*Cosmic Distance Ladder*
	SLO-2	*Equatorial System*	*Radius of a stars*	*Sun's Energy Cycle*	*Jovian planets*	*Gravitational redshift: Hubble's Law*
S-4 to S-5	SLO-1	*Problems/Demos/ Simulations/Seminars: Astronomical Units*	*Quiz on Newtonian Mechanics*	*Problems/Demos/ Simulations/Seminars: Sun's energy cycle*	*Seminar on precession of earth gas planets (Jupiter Saturn)*	*Assignment on Classification of Galaxies*
	SLO-2	*Problems/Demos/ Simulations/Seminars: Astronomical approximations*	*Problems/Demos/ Simulations/Seminars: Kepler's Laws*	*Quizthe Sun and its atmosphere*	*Seminar on precession of earth gas planets (Neptune Uranus)*	*Problems/Demos/ Simulations/Seminars: Hubble's Law*
S-6	SLO-1	*Annual Motion of the Sun*	*Classification of binary stars*	*Solar Neutrinos*	*Asteroid belt and its concepts*	*Concepts and Definitions: Galaxy Clusters*
	SLO-2	*Seasons*	*Determination of Masses from Binary orbits*	*Solar Seismology and Sun spots*	*Kuiper belt and its concepts*	*Super Clusters, Active Galaxies*
S-7	SLO-1	*Basic Definitions: The Ecliptic's Tilt*	*Doppler Shift*	*Sun Flares,*	*Oort cloud*	*Concepts and Definitions: Quasars*
	SLO-2	*Equinoxes and Solstice, Precession*	*Stellar Spectral Classification*	*Solar Cycle*	*Facts about the Oort Cloud and its location*	*What is Dark Matter?*
S-8	SLO-1	*Basic Definitions: Calendar Weeks, Months Years, Leap Years*	*Hertzsprung-Russell Diagram*	*Overview of Stellar Evolution*	*Qualitative idea of Planetary Rings, Extra-Solar Planets*	*Dark matter in Cluster of Galaxies qualitative overview*
	SLO-2	*Sidereal Time*	*Organization of stars according to spectral series*	*Stages of star's formation and Star Evolution Cycle*	*Comets-Meteors, Meteorites*	*Cosmology- Concept of Evolution of universe*
S-9 to S-10	SLO-1	*Problems/Demos/ Simulations/Seminars: Seasons*	*Seminar: Magnification Light Gathering Power, Resolving Power*	*Assignment on Tracking changes with HR diagram*	*Quiz onon Asteroid and Kuiper Belts*	*Assignment on Meaning of Red Shift and Age of Universe*

	SLO-2	*Problems/Demos/ Simulations/Seminars: Equinoxes and Solstice*	*Problems/Demos/ Simulations/Seminars:*	*Quiz on the Stellar Evolution*	*Quiz on the Oorts Cloud*	*Seminar on any of the above topics*
S-11	**SLO-1**	*Moon's Rotation*	*Introduction of telescopes*	*Main Sequence stars*	*Basic Structure of the Milky Way*	*Olber's Paradox*
	SLO-2	*Eclipses*	*Classification of telescopes*	*Supernovae (mass limits)*	*Properties of the Milky Way*	*Visible Universe*
S-12	**SLO-1**	*Shape and Size of Earth*	*reflective and refractive Phenomena in telescopes*	*Concepts and Definitions: White Dwarfs, Supernovae classification and remnants*	*Mass and Density*	*Concepts and Definitions: the Big Bang*
	SLO-2	*Measuring the diameter of astronomical objects*	*Errors and rectification in telescopes*	*Neutron stars and Pulsar*	*Stars and Star Clusters of the Milky Way*	*Cosmic Microwave Background*
S-13	**SLO-1**	*Night Sky*	*Limitations of telescopes*	*Concepts and Definitions: Black Holes*	*Galactic Nucleus, Edge of the Milky Way*	*Concepts and Definitions: Beginning of the universe and various stages*
	SLO-2	*Constellations*	*X-ray observation techniques Gamma Ray Astronomy*	*Schwarzschild radius*	*Spiral Arms of the Milky Way*	*Radiation Matter Antimatter, fusion, galaxy formation and present.*
S-14 to S-15	**SLO-1**	*Problems/Demos/ Simulations/Seminars: Night Sky*	*Problems/Demos/ Simulations/Seminars: Telescopes*	*Problems/Demos/ Simulations/Seminars: Energy Stars and Supernovas*	*Quiz on Milkyway*	*Problems/Demos/ Simulations/Seminars: Obler's Paradox*
	SLO-2	*Problems/Demos/ Simulations/Seminars: Eclipses*	*Seminar on Classifications of Telescopes*	*Problems/Demos/ Simulations/Seminars: Sun's Black holes*	*Problems/Demos/ Simulations/Seminars: Edge of MilkyWay*	*Seminar on Cosmoogy*

Learning Resources	1. Pathways to Astronomy, Thomas T Arny, Stephen E Schneider, (McGraw-Hill College, 2008) 2. Universe, Freedman and Kaufmann, (W. H. Freeman; 8th edition, 2008) 3. An Introduction to Modern Astrophysics, Bradley W Carroll and Dale AOstlie (Addison-Wesley Publishing, 1996)	4. Introduction to Stellar Astrophysics,Bohm-Vitense, Erika. (3 Vols. Cambridge University Press, 1989) 5. Astrophysical Concepts, Martin Harwit (Springer Science & Business Media, Science2000)

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

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

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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	Prof. Alka Upadhayay, Thapar University, alka.iisc@gmail.com	Dr. Triparno Bandyopadhy

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

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

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

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

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

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

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

Learning Assessment

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

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

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Course Code	UCY23G03T	Course Name	Food Chemistry	Course Category	G	Generic Elective	L	T	P	O	C
							3	1	0	2	4

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

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

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

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Introduction	Water: Introduction	Carbohydrates- composition, sources	Mineral functions, sources,	Food safety: Introduction
	SLO-2	Why food science	Chemistry of water	Classification	Bio-availability	Foodborne illness
S-2	SLO-1	Introduction to nutrition –	Water as a nutrient, function, sources, requirement	Structure, Functions.	deficiency of following minerals and effects: calcium,	Biological hazard to the food
	SLO-2	Functions of foods	water balance – effect of deficiency.	physical & chemical properties.	Iron	Chemical hazard to the food
S-3	SLO-1	definition of nutrition, nutrients.	Moisture in food: Hydrogen bonding	Other sweetening agents, functions of sugar in food	Iodine, Fluorine	Food protection systems
	SLO-2	Adequate, optimum and good nutrition, malnutrition.		changes during cooking and processing.	sodium, potassium	Labelling as a means of assuring food safety
S-4	SLO-1	Tutorial session	Tutorial session	Tutorial session	Tutorial session	Tutorial session
	SLO-2					
S-5	SLO-1	Food as a source of nutrients	Free, bound and entrapped water	Proteins – composition	Vitamins – Classification, units of measurement, sources,	Food preservations: Introduction
	SLO-2	Different sources: vegetables, fruits, meats etc		Classification, sources,	functions	Heat preservation, Refrigeration, dehydration, concentration
S-6	SLO-1	Inter relationship between nutrition and health,	Water activity and Food stability.	Functions, determination of protein quality	deficiency diseases caused by following vitamins: Fats soluble vitamins – Vitamin A, D	Added preservatives
	SLO-2	visible symptoms of good health.		denaturation, and protein deficiency	Vitamin E and K	Other preservation techniques
S-7	SLO-1	Food guide-basic five food groups	Energy – Unit of energy, food as a source of energy	Amino acids – classification, Physio-chemical properties	Water soluble vitamins – Vitamin C	Nutritive value of the preserved food
	SLO-2	usage of food guide		modification of food protein through processing and storage	Vitamin B-complex	Safety of the preserved food
S-8	SLO-1	Tutorial session	Tutorial session	Tutorial session	Tutorial session	Tutorial session

Duration (hour)		12	12	12	12	12
	SLO-2					
S-9	SLO-1	Use of food in body-digestion, absorption, transport, utilization of nutrients in the body	Energy value of food, the body's need for energy,	Lipids – composition, nomenclature	Enzymes. Nomenclature, specificity, catalytic regulations	Food additives: Introduction
	SLO-2		B.M.R. activities	saturated, unsaturated fatty acids	enzyme activity, controlling enzyme action	Functions
S-10	SLO-1	Food choice: Healthy	Utilization of food for energy requirements	classification, food sources,	Enzyme added to food during processing, modification of food by endogenous enzyme	Major additives used: coloring agents, flavoring agents
	SLO-2	Food choice: Unhealthy		functions of fats		Antioxidants, enzymes
S-11	SLO-1	Food poisoning	Acid – base balance	Physical and chemical properties of fat	Enzyme inhibitors in food	Food packaging: types, materials, functions
	SLO-2	Expiration dates		Role of food lipids in flavor		Food packaging: controlling atmosphere, protection
S-12	SLO-1	Tutorial session	Tutorial session	Tutorial session	Tutorial session	Tutorial session
	SLO-2					

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

Learning Assessment

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

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

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

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Course Code	UPY23P03L	Course Name	Mini Project	Course Category	P	Project	L	T	P	O	C
							0	0	4	2	2

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:	*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 physics*	
CLR-3:	*promote independent and collaborative research work in the domain of physics*	
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 physics*	

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 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
Mini Project	20%	30 %	30%	20 %

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SEMESTER VII

Course Code	UPY23701L	Course Name	Advanced Laboratory	Course Category	C	Professional Core Course	L	T	P	O	C
							0	0	8	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:*
CLR-1 :	*Preparation procedure of various nanomaterials*
CLR-2 :	*Acquire knowledge about structure and microstructures of as-prepared nanomaterials*
CLR-3 :	*Learn the advanced characterization instruments*
CLR-4 :	*Apply the basics of computational modeling and simulation using DFT*
CLR-5 :	*Solve wave equation*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning 1 Level of Thinking (Bloom)	Learning 2 Expected Proficiency (%)	Learning 3 Expected Attainment (%)	PLO 1 Fundamental Knowledge	PLO 2 Application of Concepts	PLO 3 Link with Related	PLO 4 Procedural Knowledge	PLO 5 Skills in Specialization	PLO 6 Ability to Utilize	PLO 7 Skills in Modeling	PLO 8 Analyze, Interpret Data	PLO 9 Investigative Skills	PLO 10 Problem Solving Skills	PLO 11 Communication Skills	PLO 12 Analytical Skills	PLO 13 PSO -1	PLO 14 PSO -2	PLO 15 PSO-3
CLO-1 :	*Generate the interest on synthesis and fabrication of nanomaterials.*	*2*	*75*	*60*	*H*	*H*	-	-	-	*H*	-	-	-	-	-	-	-	-	-
CLO-2 :	*Impart knowledge about characterization methods*	*2*	*80*	*70*	*H*	*H*	-	-	-	*H*	-	-	-	-	-	-	-	-	-
CLO-3 :	*Exploring the advanced characterization techniques.*	*2*	*70*	*65*	*H*	*H*	-	-	-	*H*	-	-	-	-	-	-	-	-	-
CLO-4 :	*Understanding the importance of computational modeling and simulation in DFT*	*2*	*70*	*70*	*H*	*H*	-	-	-	*H*	-	-	-	-	-	-	-	-	-
CLO-5 :	*Solving the wave questions using Numerov's method.*	*2*	*80*	*70*	*H*	*H*	-	-	-	*H*	-	-	-	-	-	-	-	-	-

DURATION (HOURS)		24	24	24	24	24
S-1 to S-8	SLO-1	*Synthesis of metal oxide nanoparticle using wet chemical preparation*	*Elemental and composition analysis using SEM*	*Determination of wavelength absorbance and band gap using UV-Vis spectroscopy*	*Determination of roughness for metal oxide thin film by AFM*	*Determination of Least square fit for a given data*
	SLO-2					
S-9 to S-16	SLO-1	*Determination of lattice parameter and indexing of XRD pattern*	*Calculation of scattering of light from metallic nanoparticles*	*Determination of mineral concentration using XRF spectrometer for metal oxide/nanoparticle*	*Determination of resistivity of germanium crystal at different temperature and estimation of band gap using four probe method*	*Solve schrodinger wave equation in one dimension for harmonic oscillator using Numerov's method.*
	SLO-2					
S-17 to S-24	SLO-1	*Thin film fabrication using dip/spin coating method*	*Identification of functional group using FTIR spectroscopy for nanomaterials.*	*Solve the boundary value problem of nonlinear ordinary differential equation*	*Determination of Hall coefficient, carrier density and carrier mobility for a given semiconductor wafer.*	*Repeat/Revision of experiment*
	SLO-2					

Learning Resources		
	1. P.M. Martin, Handbook of Deposition Technologies for Films and Coatings, 3rd Ed., Elsevier Inc., 2010.	1. Mario Birkholz, Thin Film Analysis by X-ray scattering, John Wiley and Sons, 2006.
	2. Gauglitz, Gunter, and Tuan Vo-Dinh, Handbook of Spectroscopy, John Wiley and Sons, 2006.	2. Pretsch, Emo, et al. Structure Determination of Organic Compounds, Vol. 13. Berlin, Springer, 2009.
	3. Yang Leng, Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, John Wiley and Sons, 2009	3. E. Hairer, S.P. Norsett and G. Wanner, Solving Ordinary Differential Equations I, Vol. 1 2000.
	4. V. Raghvan, Experiments in Materials Science, 5th Ed., PHI Learning Pvt. Ltd., 2004	4. F. J. Garci'a de Abajo and A. Howie, Retarded field calculation of electron energy loss in inhomogeneous dielectrics, Phys. Rev. B 65, 115418, 2002.

Learning Assessment

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

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

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Dr. Ajay Singh, BARC, Mumbai, ajay@barc.gov.in	Prof. S Balakumar, University of Madras, balakumar@unom.ac.in	Dr. Ravikirana, SRMSIT

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Course Code	UPY23D05J	Course Name	Advanced Computational Physics	Course Category	D	Descipline Specific Core Course	L	T	P	O	C
							3	0	2	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning 1	2	3
CLR-1 :	molecular dynamics using lj potential			
CLR-2 :	understand the dft for materials modeling			
CLR-3 :	learn the fundamental concepts of monte-carlo methods			
CLR-4 :	ability to use and dft code and interpret its outcome			
CLR-5 :	ability to run simple ising model			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	understand molecular dynamics	2	75	60
CLO-2 :	understand the density functional theory	2	80	70
CLO-3 :	run dft code and interpret the results	2	70	65
CLO-4 :	understand monte carlo method	2	70	70
CLO-5 :	write code for monte carlo method	2	80	70

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

Duration (hour)		15	15	15	15	15
S-1	SLO-1	*Equations of Motions for atomic systems*	Solving Schrodinger's equation using variational method/Numerov Method (Any one)	Familiarize with DFT code Quantum Espresso (QE)	RNG	Generation of Random Alloy with cubic lattice
	SLO-2	*Equations of Motions for atomic systems*	Solving Schrodinger's equation using variational method/Numerov Method (Any one)	Access and install QE	RNG quality check	Cubic lattice Space group
S-2	SLO-1	*Equations of Motions for atomic systems*	Solving Schrodinger's equation using variational method/Numerov Method (Any one)	Familiarize the input file	LCG algorithm	hkl indices for sc, fcc and bcc
	SLO-2	*Equations of Motions for atomic systems*	Solving Schrodinger's equation using variational method/Numerov Method (Any one)	Revisit Fortran namelist	LCG algorithm, Small discussion on Marasaglia KISS algorithm	hkl indices for sc, fcc and bcc
S-3	SLO-1	Molecular Dynamics of hard Particles	Hellman-Feynmann Theorem	Pseudopotential source	*Metropolis algorithm*	Develop the lattice
	SLO-2	Molecular Dynamics of hard Particles	Hellman-Feynmann Theorem	Pseudopotential source	*Metropolis algorithm*	Add basis to the lattice
S-4 to 5	SLO-1	Practice 1:	*Practice 3: Helium Atom*	*Input file creaton from cif*	*Practice 6: LCG*	*Randomize the basis using LCG*
	SLO-2					
S-6	SLO-1	Molecular Dynamics of hard Particles	*Many body hamiltonian and its problems*	*SCF calculation of simple systems: Fe, Si, C*	*Metropolis algorithm*	Ising Model Simulation
	SLO-2	Molecular Dynamics of hard Particles	*Many body hamiltonian and its problems*	*Understand the space group and bravis lattice*	*Metropolis algorithm*	*Revisit the π calculation*
S-7	SLO-1	Molecular Dynamics of hard Particles	*Born-Oppenheimer and Hartree-Fock approximation*	*Analysis of the structures*	*Ising Model*	*Energy calculation with nearest neighbours*
	SLO-2	Molecular Dynamics of hard Particles	*Born-Oppenheimer and Hartree-Fock approximation*	*Analysis of the structures*	*Ising Model*	*Detail balance*
S-8	SLO-1	Constant pressure MD	*Introduction to DFT*	*Create the input*	*Heisenberg Model*	*Single spin flip model and change in energy*
	SLO-2	Constant pressure MD	*Introduction to DFT*	*Analysis of input tags*	*Heisenberg Model*	*Single spin flip model and change in energy: Metropolis Algorithm*

S-9 to 10	**SLO-1**	*Practice 2:*	*Practice 4:*	*Run the code for SCF*	*Practice 7: KISS Algorithm*	*Calculate T_c, χ*
	SLO-2					
S-11	**SLO-1**	Constant temperature MD	*Hohenberg-Kohn Theorem*	*NSCF calculation of simple systems: Fe, Si, C*	*Heisenberg Model*	*Kinetic Monte Carlo Simulation*
	SLO-2	Constant temperature MD	*Constrained search*	*Understand the difference between SCF and NSCF*	*Heisenberg Model*	*Difference with Metropolis algorithm*
S-12	**SLO-1**	Grand canonical MD	*Kohn-Sham equation*	*Compare the structures after SCF*	*Kinetic Monte Carlo*	*Metropolis algorithm is not a dynamic properties*
	SLO-2	Grand canonical MD	*Kohn-Sham equation*	*Compare the structures after SCF*	*Kinetic Monte Carlo*	*Metropolis algorithm is not a dynamic properties: discussion*
S-13	**SLO-1**	Grand canonical MD	*Exchange-Correlation function*	*DOS and band: background*	*Kinetic Monte Carlo*	*Dynamic properties with KMC*
	SLO-2	Grand canonical MD	*Exchange-Correlation function*	*DOS and band: background*	*Kinetic Monte Carlo*	*Dynamic properties with KMC-II*
S-14 to 15	**SLO-1**	*Discussion*	*LDA GGA and PBE*	*Run the code for NSCF*	*Discussion*	*Calculate properties using KMC*
	SLO-2					

Learning Resources	1. Computer Simulation of Liquids, Allen and Tildseley, 2nd Ed, OUP, 2017 2. *Electronic Structure: Basic Theory and Practical Methods,2nd ed, R.M. Martin, CUP, 2020*	3. *A Guide to Monte Carlo Simulations in Statistical Physics, 2nd ed Landau and Binder, CUP,2020* 4. *Computational Physics,* Jos Thijssen, OUP, 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	30%	30%	30%	30%	30%	30%	30%	30%	30%	-
	Understand										
Level 2	Apply	40%	40%	50%	40%	50%	40%	50%	40%	50%	-
	Analyze										
Level 3	Evaluate	30%	30%	20%	30%	20%	30%	20%	30%	20%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

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

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Course Code	UPY23D06J	Course Name	Quantum Optics	Course Category	D	Descipline Specific Core Course	L	T	P	O	C
							3	0	2	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 :	emphasize the importance of quantum optics to quantum information science	1
CLR-2 :	understand quantum nature of light	2
CLR-3 :	learn cavity-based light-matter interaction	3
CLR-4 :	acquire more advanced knowledge on quantum optics	
CLR-5 :	learn atom-photon interactions	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	understand the concepts on Photon statistics	2	75	60
CLO-2 :	comprehend non-classical behaviour of light: Photon antibunching	2	80	70
CLO-3 :	iInterpret the detection and generation of squeezed states of light	2	70	65
CLO-4 :	formulate the photon number states	2	70	70
CLO-5 :	analyze atom-cavity coupling	2	80	70

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

Duration (hour)		15	15	15	15	15
S-1	SLO-1	Introduction to quantum optics	Introduction to photon antibunching	Light waves as classical harmonic oscillators	Introduction to resonant light-atom interactions	Introduction to atoms in cavities
	SLO-2	A brief history of quantum optics	Intensity interferometers:	Light waves as classical harmonic oscillators	Introduction to resonant light-atom interactions	Optical Cavities
S-2	SLO-1	Introduction to photon-counting Statistics	Michelson stellar interferometer	Light as a quantum harmonic oscillator	Two-level atom approximation,	Review on Fabry-Perot cavity
	SLO-2	Coherent light	Hanbury Brown-Twiss experiments	Light as a quantum harmonic oscillator		Photon decay rate
S-3	SLO-1	Poissonian photon statistics,	classical intensity fluctuations	The vacuum field,	Coherent superposition states,	Quality factor
	SLO-2	Classification of light by photon statistics,	classical intensity fluctuations	The vacuum field,		Atom-cavity coupling
S-4 to S-5	SLO-1	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars
	SLO-2					
S-6	SLO-1	Super-Poissonian light,	Second order correlation function	Coherent states,	Density matrix	
	SLO-2	Thermal light	Second order correlation function	Shot noise and	Time-dependent Schrodinger equation,	Weak and strong coupling
S-7	SLO-1	Thermal light	Hanbury Brown-Twiss experiments with photons	number-phase uncertainty	weak field limit	Weak coupling: Preliminary considerations,
	SLO-2	Sub-Poissonian light	Hanbury Brown-Twiss experiments with photons	Squeezed states,	Strong field limit	Free-space spontaneous emission,
S-8	SLO-1	Degradation of photon statistics by losses	Photon bunching and antibunching	Squeezed states,	The weak field limit: Einstein's B coefficient	Spontaneous emission in a single mode cavity
	SLO-2	Theory of photodetection	Coherent light	Detection of Squeezed light,	The weak field limit: Einstein's B coefficient	Purcell effect
S-9 to S-10	SLO-1	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars
	SLO-2					
S-11	SLO-1	Semiclassical theory of photodetection	Bunched light	Detection of quadrature-Squeezed vacuum states	The strong field limit: Rabi oscillations	Experimental demonstration of the Purcell effect
	SLO-2	Quantum theory of photodetection	Antibunched light	Detection of amplitude-squeezed light	The strong field limit: Rabi oscillations	Strong coupling
S-12	SLO-1	Quantum theory of photodetection	Experimental demonstration of photon antibunching	Generation of squeezed states	Damping	Cavity quantum electrodynamics

	SLO-2	*shot noise in photodiodes*	*Experimental demonstration of photon antibunching*	*Squeezed vacuum states*	*Damping*	*Experimental observations of strong coupling*
S-13	**SLO-1**	*Observation of sub-Poissonian photon statistics*	*Single Photon sources*	*amplitude-squeezed light*	*Experimental observations of Rabi oscillations*	*Applications of cavity effects*
	SLO-2	*Observation of sub-Poissonian photon statistics*	*Single Photon sources*	*Quantum noise in amplifiers*	*Experimental observations of Rabi oscillations*	*quantum information science*
S-14 to S-15	**SLO-1** **SLO-2**	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*

Learning Resources	1. Quantum Optics: An Introduction, Mark Fox, (Oxford University Press) 2. Quantum Optics, M.O. Scully, M.S. Zubairy, (Cambridge University Press)	3. Introduction to Quantum Optics: From Light Quanta to Quantum Teleportation, Harry Paul (Cambridge University Press) 4. Quantum Optics for Beginners, Z. Ficek, M. R. Wahiddin (Pan Stanford Publishing)

Learning Assessment

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

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

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. R Seshadri, Titan Company Limited, seshadri@titan.co.in	Dr. M. Ameen, CUSAT, ameenpoyli@cusat.ac.in	*Dr. K Shadak Alee, SRMIST*
Dr. M Satish, CSIR-CECRI, msathish@cecri.re.in	Dr. Maruthi Manoj B, IIT KGP, bmmanoj@phy.iitkgp.ac.in	*Dr. Jayavardhan Sinha, SRMIST*

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

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

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

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

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

Duration (hour)		12	12	12	12	12
S-1	SLO-1	*Fundamentals of vacuum*	*Substrate deposition technology*	*Chemical bath deposition : ionic and solubility products*	*Introduction to elasticity*	*X-ray diffraction (XRD)*
	SLO-2	*Basic definition and pressure regions of vacuum*	*Substrate materials,*	*Preparation of binary semiconductors*	*Plasticity and mechanical behavior*	*Experimental investigation of X-ray diffraction (XRD*
S-2	SLO-1	*Kinetic theory of gases, mean free path*	*Substrate cleaning*	*Deposition mechanism*	*Electrical and magnetic properties of thin films*	*Scanning electron microscopy*
	SLO-2	*Kinetic theory of gases, mean free path*	*Masks and connections*	*Preparation of compound thin films*	*Introduction to electrical properties of thin films,*	*Morphology analysis using scanning electron microscopy*
S-3	SLO-1	*Understanding concepts and types of gas flow*	*Thermal evaporation*	*Electrodeposition*	*Optical properties of thin films*	*Transmission electron microscopy*
	SLO-2	*Types of flow*	*Thermal evaporation*	*Electrolytic deposition*	*Optical constant in thin films*	*Transmission electron microscopy*
S-4	SLO-1	*Conductance*	*Resistive heating*	*Electro less deposition*	*Theory of nucleation and growth process*	*Investigation of nanostructures using transmission electron microscopy*
	SLO-2	*Vacuum pumps*	*Flash evaporation*	*Anodic oxidation*	*Early stages of film growth*	*Investigation of nanostructures using transmission electron microscopy*
S-5	SLO-1	*Vacuum pumps and systems*	*Rf-heating*	*Spray pyrolysis*	*Thermodynamic aspects of nucleation*	*Energy dispersive analysis*
	SLO-2	*Rotary mechanical pump*	*Co-evaporation*	*Spin coating*	*Capillary theory*	*Elemental analysis using energy dispersive analysis*
S-6	SLO-1	*Rotary mechanical pump*	*Co-evaporation*	*Dip coating*	*Thin film growth modes*	*Auger electron spectroscopy*
	SLO-2	*Roots pump*	*Electron bombardment heating*	*Chemical vapor deposition (cvd)*	*Volmert, weber (vw) growth*	*Auger electron spectroscopy*
S-7	SLO-1	*Diffusion pump*	*Sputtering plasma*	*Homogenous process*	*Frank-van der merwe (fm) growth*	*Study of surface using auger electron spectroscopy*
	SLO-2	*Diffusion pump*	*Discharges and arc*	*Heterogeneous process,*	*Stranski-krastanov growth*	*Study of surface using auger electron spectroscopy*
S-8	SLO-1	*Turbo molecular pump*	*Sputtering yield low pressure sputtering*	*Cvd reactions*	*Thickness measurement*	*Basic principle of x-ray photoelectron spectroscopy*

	SLO-2	*Turbo molecular pump*	*Rf-sputtering*	*Pyrolysis*	*Electrical methods*	*Experimental details of x-ray photoelectron spectroscopy*
S-9	**SLO-1**	*Measurement of vacuum*	*Reactive sputtering*	*Hydrogen reduction, halide disproportionation,*	*Microbalance monitors*	*Identify elements within materials from x-ray photoelectron spectroscopy study*
	SLO-2	*Concept of different gauges*	*Basic principle of magnetron sputtering*	*Transfer reactions*	*Quartz crystal monitor*	*Uv-vis spectroscopy, theory and applications*
S-10	**SLO-1**	*Capacitance gauges*	*Details study of magnetron sputtering*	*Cvd processes and systems*	*Basic of mechanical method (stylus)*	*Uv-vis spectroscopy, theory and applications*
	SLO-2	*Pirani gauge*	*Magnetron configurations*	*Low pressure CVD*	*Mechanical method (stylus)*	*Introduction of secondary ion mass spectrometry*
S-11	**SLO-1**	*Ionization gauge and penning gauge*	*Evaporation versus sputtering*	*Laser enhanced cvd*	*Ellipsometry*	*Experimental study of secondary ion mass spectrometry*
	SLO-2	*Vacuum system components*	*Evaporation versus sputtering*	*Metal organic cvd (mocvd)*	*Interference fringes*	*Use of secondary ion mass spectrometry*
S-12	**SLO-1**	*Problems/Demos/ Simulations/Seminars on mean free path from kinetic theory of gases, and different gauges*	*Problems/Demos/ Simulations/Seminars on rf and resistive heating*	*Problems/Demos/ Simulations/Seminars on electrodeposition and MOCVD*	*Problems/Demos/ Simulations/Seminars on nucleation*	*Problems/Demos/ Simulations/Seminars on crystallite size, strain analysis using XRD*
	SLO-2	*Problems/Demos/ Simulations/Seminars on vacuum operation*	*Problems/Demos/ Simulations/Seminars on evaporation versus sputtering*	*Problems/Demos/ Simulations/Seminars on low pressure CVD and CVD reactions*	*Problems/Demos/ Simulations/Seminars on thickness analysis and crystal monitor*	*Problems/Demos/ Simulations/Seminars on morphology study from SEM and TEM data*

Learning Resources

1. D.M. Hoffman, B. Singh and J.H. Thomas, Handbook of Vacuum Science & Technology, Academic Press, 1998.
2. M. Ohring, Materials Science of Thin Films: Deposition and Structure, 2nd Ed., Academic Press (An Imprint of Elsevier), 2002.
3. Properties of Thin Films by Joy George, Marcel and Decker, (1992).
4. Kaufmann, Characterization of Materials, 2nd Ed., Wiley, 2003.
5. K.L. Chopra, Thin Film Phenomena, Robert E. Krieger Publishing Company, 1979.
6. Z.L. Wang, Characterization of Nanophase Materials, Wiley, 2000.
7. Thin Film Technology by O S Heavens, Methuen young books (1970).
8. N. Yoshimura, Vacuum Technology: Practice for Scientific Instruments, Springer Publications, 2007.
9. The Vacuum Technology Book Volume II, Pfeiffer Vacuum [Online Book]
10. E. Ahmed, et al. "Significance of substrate temperature on the properties of flash evaporated CuIn 0.75 Ga 0.25 Se 2 thin films." Thin Solid Films 335.1 (1998): 54-58.
11. Physics of Thin Films by Ludmila Eckertová, Springer (1986).
12. J.B. Mooney, and S.B. Radding. "Spray pyrolysis processing." Annual Review of Materials Science 12.1 (1982): 81-101.
13. R.F. Bunshah, Handbook of Deposition Technologies for Films and Coatings, Science, Technology and Applications, Noyes Publications, 1994.

Learning Assessment

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

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

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Course Code	UCY23G04T	Course Name	Pharmaceutical Chemistry	Course Category	G	Generic Elective	L	T	P	O	C
							3	1	0	2	4

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

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

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

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Introduction of drugs	Medicinally important inorganic compounds	Definition and actions of representative antibacterial agent	Storage of drugs: Importance, and different conditions	Fermentation - Aerobic and anaerobic fermentation
	SLO-2	Nature and sources of drugs		Synthesis of the representative drugs (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim)		
S-2	SLO-1	Classifications of drugs: Biological	Role of inorganic compounds	Synthesis of the representative drugs of the following classes: antibacterial agent (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim	Encapsulation of drugs	Production of Ethyl alcohol
	SLO-2	Classifications of drugs: Chemical				
S-3	SLO-1	Nomenclature of drugs	Therapeutic uses of inorganic compounds	Synthesis of the representative drugs of the following classes: antibacterial agent (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim	Brief introduction to drug delivery	Production of citric acid
	SLO-2					
S-4	SLO-1	Tutorial session	Tutorial session	Tutorial session	Tutorial session	Tutorial session
	SLO-2					
S-5	SLO-1	Drug receptor interaction	Drugs and Pharmaceuticals – I: Study of pharmaceutical aids - talc, diatomite and kaolin	Definition and actions of representative antifungal agent	Introduction - Enzymes	Production of Antibiotics - Penicillin
	SLO-2			Synthesis of the representative drugs		
S-6	SLO-1	Mechanism of drug interaction	Study of pharmaceutical aids - bentomite, gelatin and natural colours	Drugs and Pharmaceuticals – II Definition and actions of Antiviral agents	Classification of enzymes	Production of Antibiotics - Cephalosporin

Duration (hour)		12	12	12	12	12
	SLO-2			Synthesis of the representative drugs Antiviral agents (Acyclovir)	Enzyme specificity	Production of Antibiotics -Chloromycetin
S-7	SLO-1	Metabolism of drugs	Definition and actions of antipyretic drug	Definition and actions of Central Nervous System agents	Mechanism of enzyme action	Production of Antibiotics -Streptomycin
	SLO-2		Examles	Synthesis of the representative drugs Central Nervous System agents (Phenobarbital, Diazepam)		
S-8	SLO-1	Tutorial session	Tutorial session	Tutorial session	Tutorial session	Tutorial session
	SLO-2					
S-9	SLO-1	Definition of the following terms: pharmacophore-pharmacology, pharmacopeia, bacteria, virus, chemotherapy and vaccine	Basic Retro-synthetic approach for development of drug.	Definition and actions of Cardiovascular drug	Enzyme cofactor	Production of - Lysine, Glutamic acid
	SLO-2			Synthesis of the representative Cardiovascular drug (Glyceryl trinitrate)	Role of enzyme cofactor in reactions	
S-10	SLO-1	Causes and symptoms for common disease and their treatment	Definition and actions of antipyretic drug	Definition and actions of antilaprosy drug	coenzyme - – its role in enzyme reactions	Production of - Vitamin B2
	SLO-2		Synthesis of the representative drugs	Synthesis of the representative antilaprosy drugs (Dapsone)		
S-11	SLO-1	Difference between drug and poison.	Definition and actions of anti-inflammatory drug	Definition and actions of HIV-AIDS related drugs	Immobilization of enzymes	Production of - Vitamin C
	SLO-2		Synthesis of the representative drugs (Aspirin)	Synthesis of the representative HIV-AIDS related drugs (AZTZ idovudine)		
S-12	SLO-1	Tutorial session	Tutorial session	Tutorial session	Tutorial session	Tutorial session
	SLO-2					

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

Learning Assessment

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

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

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

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Course Code	UPY23G07T	Course Name	Group Theory	Course Category	G	General Elective Course	L	T	P	O	C
							3	1	0	2	4

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

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

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

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

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Definition of a Group	Reducible and Irreducible representation	Symmetry Relations and Point Group Classifications	Reciprocal Space	Character Table
	SLO-2	Definition of a Group	Reducible and Irreducible representation	Symmetry Relations and Point Group (PG) Classifications	Reciprocal Space	Character Table
S-2	SLO-1	Example of a Group Basic Definitions	Schur's Lemma and Great Orthogonality Theorem	Symmetry Relations and Point Group Classifications	Translational Group and Bloch's Theorem	Character Table
	SLO-2	Example of a Group Basic Definitions	Schur's Lemma and Great Orthogonality Theorem	Symmetry Relations and Point Group Classifications	Translational Group and Bloch's Theorem	Character Table
S-3	SLO-1	Rearrangement Theorem	Character Table	Mathematical Background for Space Groups	PG in r and k space	Space group analysis of CH_4
	SLO-2	Rearrangement Theorem	Character Table	Mathematical Background for Space Groups	PG in r and k space	Space group analysis of CH_4
S-4	SLO-1	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars
	SLO-2					
S-5	SLO-1	Cosets , Conjugation and Class	Character Table	Mathematical Background for Space Groups	SG-representation	Space group analysis of CH_4
	SLO-2	Cosets , Conjugation and Class	Character Table	Mathematical Background for Space Groups (SG)	SG-representation	Space group analysis of CH_4
S-6	SLO-1	Symmetry Planes	Character Table	Symmetry operations	SG-representation	Space group analysis of CH_4
	SLO-2	Symmetry Planes	Character Table	Symmetry operations	SG-representation	Space group analysis of CH_4
S-7	SLO-1	Inversion centre	Definition of Character	Symmorphic and Nonsymmorphic	Common Cubic-Lattices	Space group analysis of NH_3
	SLO-2	Inversion centre	Definition of Character	Symmorphic and Nonsymmorphic	Γ-point	Space group analysis of NH_3
S-8	SLO-1	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars
	SLO-2					
S-9	SLO-1	Proper and Improper axis & rotations	Characters and Class, Matrices	Bravis Lattice and SG	points with $k \neq 0$	Space group analysis of NH_3
	SLO-2	Proper and Improper axis & rotations	Characters and Class, Matrices	Bravis Lattice and SG	points with $k \neq 0$	Space group analysis of NH_3
S-10	SLO-1	Products of Symmetry operations	Schoenflies Symmetry Notation	Examples of Symmorphic SG	Nonsymmorphic Space Group	Space group analysis of NH_3
	SLO-2	Products of Symmetry operations	Schoenflies Symmetry Notation	Cubic SG and the Equivalence Transformation	Factor Group and Γ-point	Space group analysis of NH_3
S-11	SLO-1	Optical Isomerism	The Hermann–Mauguin Symmetry Notation	2D Space Group	Factor Group and Γ-point	Space group analysis of NH_3
	SLO-2	Optical Isomerism	The Hermann–Mauguin Symmetry Notation	Oblique, Square, Rectangular and Hexagonal SG	Factor Group and Γ-point	Space group analysis of NH_3

S-12	**SLO-1**	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2					

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

Learning Assessment

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

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

Course Designers

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

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Course Code	UCY23G05T	Course Name	Chemistry in Everyday life	Course Category	G	Generic Elective	L	T	P	O	C
							3	1	0	2	4

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

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

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

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Cosmetics: Introduction	Definitions and sources – Carbohydrates	Food preservatives- Definition examples	Significance of Radical chemistry in living system	Fibers: natural fibers
	SLO-2	Preparation of Talcum Powder	Definitions and sources - proteins -fats	Methods of preservation- Low and high temperature methods	Radical production in environment	Fibers: Artificial fibers
S-2	SLO-1	Preparation of shampoo	Definitions and sources - minerals	Methods of preservation- dehydration osmotic pressure	Superoxide and peroxide radicals	Artificial fibers - polyamides
	SLO-2	Preparation of tooth paste	Definitions and sources – vitamins	Methods of preservation- food irradiation	Quantification of radicals by EPR	Acrylic and polyesters
	SLO-2	Preparation of Nail Polish	Definition and source of sports supplements	Food colour chemicals used in food -soft drinks and its health hazards	Health impacts Action of radicals	PET
S-3	SLO-1	Preparation of skin creams	Physiological importance- balanced diet	Chemicals in food production	Diseases caused by free radicals	PET recycling process
	SLO-2					
S-4	SLO-1	Practice: Quiz about cosmetic materials	Practice: Quiz about sources of carbohydrates	Practice: Quiz about food preservative chemicals	Practice: Quiz about radicals' detection	Practice: Quiz about natural fibers
	SLO-2	Practice: Quiz about shampoo and nail polish	Practice: Quiz about proteins and minerals	Practice: Quiz about food preservatives methods	Practice: Quiz about EPR analysis	Practice: Quiz about synthetic fibers
S-5	SLO-1	Preparation of Perfumes	Adulterants in milk - ghee - oil- identification.	Food poisoning-Reasons	Cancer Radical quencher	Biodegradable Polymers-examples
	SLO-2					
S-6	SLO-1	Cottage industries: agarbatti	Adulterants in coffee and tea powders and its identification	Introduction to Fertilizers	Anti-oxidants- Introductions	Non-biodegradable polymers examples
	SLO-2	Preparation of bath salts	Adulterants in asafoetida - identification	Fertilizers used in natural sources	Advantages and role of antioxidants in human health	Use of polymeric materials in daily life
S-7	SLO-1	Soaps and detergents - General formulations and preparation	Adulterants in chilli powder- identification	Fertilizers-Urea- NPK need - Uses and hazards	Natural anti-oxidants like vegetables, beverages like tea and coffee, fruits	Polystyrene materials for food storage and serving

Duration (hour)		12	12	12	12	12
	SLO-2	Cosmetics for nail care	Adulterants in pulses and turmeric powder – identification	Fertilizers super phosphates- Uses and hazards	Water soluble antioxidants	PTFE in cookware
S-8	SLO-1	Practice: Oral Presentations	Practice: Oral Presentations	Practice: Oral Presentations	Practice: Oral Presentations	Practice: Oral Presentations
	SLO-2					
S-9	SLO-1	Sun screens formulation and working mechanism	Role of voluntary agencies such as, Agmark, I.S.I.	Pesticides –definition and examples	Antioxidants/Polyphenols and skin aging	Polymers in sports
	SLO-2					
S-10	SLO-1	Cosmetics used for eye care	Highlights of Food Safety and Standards Act 2006	Pesticides for public health pest control- mosquitoes, houseflies	Radical destroying enzymes: superoxide dismutase	Uses of Vinyl polymers and Bakelite
	SLO-2					
S-11	SLO-1	Possible Hazards of cosmetic use	Food Safety and Standards Authority of India (FSSAI)-Rules and Procedures	Pesticides for domestic pests - Bed bugs, cockroaches etc.	Radical destroying enzymes: catalase, peroxidase	hazards of polymers
	SLO-2					
S-12	SLO-1	Practice: Participative debates	Practice: Participative debates	Practice: Participative debates	Practice: Participative debates	Practice: Participative debates
	SLO-1	Practice: Summarizing all concepts	Practice: Summarizing all concepts	Practice: Summarizing all concepts	Practice: Summarizing all concepts	Practice: Summarizing all concepts

Learning Resources	Theory:

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

Learning Assessment

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

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

Course Designers

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

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Course Code	UPY23P04L	Course Name	Internship - III	Course Category	P	Internship/ Project	L	T	P	O	C
							0	0	0	0	2

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:
CLR-1:	*assist the student's professional skill development useful to employer such as teamwork, communications and work ethics & details*
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:
CLO-1:	*demonstrate the skill gained through work experience with mentors or successful professionals to support the early stages of their career*

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

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Course Code	UPY23P05L	Course Name	Project Phase -I	Course Category	P	Internship/Project	L	T	P	O	C
							0	0	8	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:	*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 physics*	
CLR-3	*promote independent and collaborative research work in the domain of physics*	
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 physics*	

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	*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
Project Phase-II	20%	30 %	30%	20 %

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SEMESTER VIII

Course Code	UPY23801J	Course Name	Nuclear and Particle Physics	Course Category	C	Professional Core Course	L	T	P	O	C
							3	0	2	2	4

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*gain an understanding of nuclear length scales and interaction strengths*
CLR-2 :	*gain an understanding of models of nuclear formation and binding energy*
CLR-3 :	*understand some applications of nuclear physics*
CLR-4 :	*learn about nuclear decays and selection rules*
CLR-5 :	*be introduced to the principles of elementary particle physics*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	*to perform multipole expansion to model physical systems*	*2*	*75*	*60*	H	H	-	-	-	-	-	-	-	M	-	-	-	-	-
CLO-2 :	*apply concepts of angular momentum and parity to solve complex problems*	*2*	*80*	*70*	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
CLO-3 :	*solve problems involving quantum mechanical tunnelling-probability*	*2*	*70*	*65*	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*compute cross-sections and decay rates of relativistic and quantum mechanical particles*	*2*	*70*	*70*	-	H	-	-	H	-	-	-	-	H	-	-	-	-	-
CLO-5 :	*describe the fundamental interactions of nature*	*2*	*80*	*70*	H	M	-	-	-	-	-	-	-	M	-	-	-	-	-

Duration (hour)		15	15	15	15	15
S-1	SLO-1	*Relevant Units*	*Nucleon-Nucleon Potential*	*Radioactive Decays*	*Selection Rules*	*The Fundamental Forces*
	SLO-2	*Scales Involved*	*Arguments for Shell Model*	*The Radioactive Decay Law*	*Non-Conservation of Parity*	*Relative Strengths*
S-2	SLO-1	*Radius of The Nucleus*	*Shell Model Theory*	*Carbon Dating*	*Wu's Experiment Description*	*Symmetry in Particle Physics*
	SLO-2	*Charge Distribution*	*Magic Numbers*	*Trace element detection*	*Interpretation\ of Wu's Experiment; and\ Goldhaber's Experiment*	*Different Quantum Numbers*
S-3	SLO-1	*Nuclear Binding Energy*	*Spin-Orbit Term*	*Alpha Decay*	*Radiation in Quantum Mechanics*	*Charge, and Spin*
	SLO-2	*Binding Energy Curve*	*Validity and Limitations*	*Examples of Alpha Decay*	*Gamma Decay*	*CPT*
S-4 to 5	SLO-1	*Problem-Solving on Charge Distribution and Binding Energy*	*Problem-Solving on the Shell Model*	*Problems on Nuclear Decay*	*Problems on Beta-decay Selection Rules*	*Problems on the Quark Model and Pion Decay*
	SLO-2					
S-6	SLO-1	*Abundance of Elements*	*Rotational Spectrum (1)*	*Theory of Alpha Decay*	*Spin-Parity in Gamma Decays*	*Leptons*
	SLO-2	*Isotopes*	*Rotational Spectrum (2)*	*Gamow Factor*	*Selection Rules in Gamma Decays*	*Quarks and Gluons*
S-7	SLO-1	*Liquid Drop Model*	*The Deuteron Problem*	*Spin-Parity in Alpha Decay*	*Internal Conversion and Auger Electrons*	*Flavor Symmetries*
	SLO-2	*Contributions to Binding Energy*	*Binding Energy*	*Alpha Decay Selection Rules*	*Coefficients of Internal Conversion*	*Gell-Mann–Nishijima Formula*
S-8	SLO-1	*Bethe-Weiszacker Formula*	*Square Well Potential*	*Beta Decay*	*Types of Nuclear Reactions*	*Isospin and SU(2) of Flavor*
	SLO-2	*Validity and Limitations*	*n-n and p-n interactions*	*Inverse beta decay & Electron Capture*	*Nuclear Fusion*	*SU(2) algebra*
S-9 to 10	SLO-1	*Problems on the Liquid Drop Model*	*Problems on Rotational Spectra*	*Problems on Tunneling*	*Problems on gamma decay selection rules and Internal Conversion*	*Problems on SU(2)*
	SLO-2					
S-11	SLO-1	*Angular Momentum*	*Spin-Parity of Deuteron*	*Fermi Theory of Beta Decay*	*Nuclear Fission*	*Scalar and Vector Mesons*
	SLO-2	*Parity*	*Central and Tensor Forces*	*Four Fermi Interactions*	*Emitted neutrons in Nuclear Fission*	*Baryons*

S-12	**SLO-1**	*Multipole Expansion*	*Dipole and Quadrupole Moments*	*Fermi-Curie Plot*	*Compound Nuclei*	*Weak Interactions from Beta Decay*
	SLO-2	*EM moments*	*Saturation Property*	*Neutrinos*	*Partial Width*	*W and Z Bosons*
S-13	**SLO-1**	*Excited States*	*Yukawa Theory Introduction*	*Gamow-Teller and Fermi Transitions*	*Direct Reactions*	*The Standard Model: Overview*
	SLO-2	*Metastable Isomers*	*Yukawa Theory Derivation*	*Spin-Parity in Beta Decays*	*Energetics of Direct Reactions*	*The Standard Model: Spectrum*
S-14 to 15	**SLO-1**	*Problems on EM moments*	*Problems on Yukawa Theory*	*Problem-Solving on Beta Decay and the Fermi Theory*	*Problems on Nuclear Scattering*	*Problems on Weak Interactions*
	SLO-2					

Learning Resources	1. *Nuclear Physics, S. N. Ghoshal, S Chand. (Text)* 2. *R R Roy and B P Nigam, Nuclear Physics: Theory and Experiments, New Age International. (Text)* 3. *I Kaplan, Nuclear Physics, Addison Wesley. (Text)*	4. *B L Cohen, Concepts of Nuclear Physics, McGraw Hill. (Reference)* 5. *K S Krane, Introductory Nuclear Physics, Wiley. (Reference)* 6. *Nuclear Physics in a Nutshell, C A Bertulani, PUP. (Reference)*

Learning Assessment

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

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

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
-	Prof. Alka Upadhayay, TIET, Patiala, alka.iisc@gmail.com	Dr Triparno Bandyopadhyay, SRMIST
-	Prof Abhijit Bhattacharyya, University of Calcutta, abphy@caluniv.ac.in	Dr Rohit Dhir, SRMIST

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Course Code	UPY23D07T	Course Name	Energy Storage and Devices	Course Category	D	Discipline Specific Elective Course	L	T	P	O	C
							3	1	0	2	4

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*provides basic knowledge in the multidisciplinary field of energy storage devices and their applications*
CLR-2 :	*manage basic principles for accessible and relevant energy storage systems qualitatively.*
CLR-3 :	*learn concept and operation of available and relevant energy storage systems*
CLR-4 :	*identify different needs within energy storage.*
CLR-5 :	*cause of efficiency losses in various energy storage systems*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning: Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO): Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	*understand the basic concepts of energy storage devices.*	*2*	*75*	*60*	*H*	*H*	-	-	-	-	-	*H*	-	-	-	*H*	-	-	-
CLO-2 :	*gain the knowledge of electrochemical energy storage devices.*	*2*	*80*	*70*	*H*	*H*	-	-	-	-	-	*H*	-	-	-	*H*	-	-	-
CLO-3 :	*realize the applications of magnetic and electric energy storage system*	*2*	*70*	*65*	*H*	*H*	-	-	-	-	-	*H*	-	-	-	*H*	-	-	-
CLO-4 :	*know about the fuel cell based energy storage system*	*2*	*70*	*70*	*H*	*H*	-	-	-	-	-	*H*	-	-	-	*H*	-	-	-
CLO-5 :	*understand the basic concepts of hydrogen production and storage*	*2*	*80*	*70*	*H*	*H*	-	-	-	-	-	*H*	-	-	-	*H*	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	*Definition and units of energy*	*Important Practical Parameters in electrochemical cells*	*Magnetic and Electric energy storage system*	*Basics Fuel cell definition*	*Hydrogen production-From fossil fuels*
	SLO-2	*Power*	*Conceptual understanding*	*Magnetic energy density basics from MH curve*	*Difference between batteries and fuel cells*	*Electrolysis*
S-2	SLO-1	*Definition and units of conservation of energy*	*Electrochemical energy*	*Magnetic energy storage materials and working principle*	*Fuel cell history*	*Thermal decomposition*
	SLO-2	*Concepts of energy conservation*	*Introduction to Batteries, components and functions*	*Superconducting Magnetic Energy Storage (SMES)*	*Challenges*	*Thermal decomposition*
S-3	SLO-1	*Definition of Second law of thermodynamics*	*Primary Batteries*	*Dielecctics basics*	*Components of fuel cells*	*Simple activity on Electrolysis*
	SLO-2	*Second law of thermodynamics and Gibbs Free Energy for Potential calculation*	*General overview*	*Dielectric energy density basics*	*Types of fuel cells*	*Simple activity on Electrolysis*
S-4	SLO-1	*Problems/Demos/*	*Problems/Demos/*	*Problems/Demos/*	*Problems/Demos/*	*Problems/Demos/*
	SLO-2	*Simulations/Seminars*	*Simulations/Seminars*	*Simulations/Seminars*	*Simulations/Seminars*	*Simulations/Seminars*
S-5	SLO-1	*Energy Production using various methods*	*Energy density of batteries- basic concept and caluculation*	*Electrical Energy storage*	*Chemical reactions in Fuel cell*	*Recent advances in hydrogen production*
	SLO-2	*Energy Production using Renewable sources*	*Energy density of batteries- basic concept and caluculation*	*Energy density from dielectric measurements*	*Chemical reactions in Fuel cell*	*Recent advances in hydrogen production*
S-6	SLO-1	*Energy resources and need for storage*	*Secondary Batteries*	*Capacitors*	*Principle of working of fuel cell*	*Photochemical reaction*
	SLO-2	*Energy storage using different methods*	*Lithium Batteries*	*Principles and Properties*	*Advantages and Disadvantages of fuel cell power plant*	*Photo catalytic*
S-7	SLO-1	*Electrical Energy storage*	*Na-Ion batteries*	*Electrochemical double layer capacitor (EDLC)*	*Fuel cell types-Alkaline fuel cell*	*Hybrid storage*
	SLO-2	*Electrical Energy density and Capacitors*	*Molten solvent Batteries*	*Principle of working of EDLC*	*Polymer electrolyte fuel cell*	*Hybrid storage*
S-8	SLO-1	*Mehanical Energy storage basics*	*Lead Acid Batteries*	*Applications of EDLC*	*Various fuel power plants in India*	*Materials for Hydrogen storage*
	SLO-2	*Mehanical Energy storage devices*	*Nickel cadmium Batteries*	*EDLC future prospects*	*Outlook and scope*	*Materials for Hydrogen storage*
S-9	SLO-1					

	SLO-2	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
S-10	**SLO-1**	*Electrochemical energy storage*	*Current scenario in Battery technology*	*Structure, Performance of EDLC*	*Phosphoric acid fuel cell*	*Metal hydrides*
	SLO-2	*Electrical energy storage*	*Current scenario in Battery technology*	*Applications of EDLC*	*Molten carbonate fuel cell*	*Metallic alloy hydrides*
S-11	**SLO-1**	*Magnetic energy storage*	*Role of Carbon materials in electrodes*	*Role of Dielelctric Materials in Electrical energy storage*	*Solid oxide fuel cell*	*Carbon Nano-tubes*
	SLO-2	*Hydrogen energy storage*	*Role of Carbon materials in electrodes*	*Role of Carbon Nanomaterials in Electrical energy storage*	*Problems with fuel, Applications of fuel cells*	*Sea as the source of deuterium*
S-12	**SLO-1**	*Student Seminar*	*Student seminar*	*Student seminar*	*Student seminar*	*Student seminar*
	SLO-2					

Learning Resources	1. R.A. Huggins, *Energy Storage*, 1st Ed., Springer, 2010. 2. J.-M. Tarascon, and Patrice Simon, *Electrochemical Energy Storage*, 1st Ed., Wiley, 2015. 3. F. Díaz-González, A. Sumper and O. Gomis-Bellmunt, *Energy storage in power systems*, 1st Ed., Wiley, 2016	4. Srinivasan, *Fuel Cells from Fundamentals to Applications*, 1st Ed., Springer, 2006. 5. Basile, A. Iulianelli, *Advances in Hydrogen Production*, 1st Ed., *Storage and Distribution*, Woodhead Publishing, 2014. 6. N. Kularatna, *Energy Storage Devices for Electronic Systems: Rechargeable Batteries and Supercapacitors*, Academic Press, 2014

Learning Assessment

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

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

Course Designers

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

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Course Code	UPY23D08T	Course Name	Atmospheric Science	Course Category	D	Discipline Specific Elective Course	L	T	P	O	C
							3	1	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	understand basics of structure and properties of earth's atmosphere
CLR-2 :	interpret the various atmospheric processes
CLR-3 :	explore the physics of extreme weather events
CLR-4 :	understand the clouds and their role in atmosphere
CLR-5 :	explore the role of weather systems

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning 1 Level of Thinking (Bloom)	2 Expected Proficiency (%)	3 Expected Attainment (%)
CLO-1 :	know the basics of earth's atmosphere	2	75	60
CLO-2 :	analyze the general weather phenomena	2	80	70
CLO-3 :	interpret the various extreme weather events	2	70	65
CLO-4 :	develop ideas of climate systems and their influence	2	70	70
CLO-5 :	distinguish the weather and climate issues	2	80	70

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

Duration (hour)		12	12	12	12	12
S-1	SLO-1	A Brief Survey of the Atmosphere: Chemical Composition	Gas Laws	Water Vapor in Air	Nucleation of Water Vapor Condensation, Theory	The Effect of Friction
	SLO-2	Vertical structure	Virtual Temperature	Moisture Parameters	Cloud Condensation Nuclei	The Gradient Wind & The Thermal Wind
S-2	SLO-1	Components of the Earth System: The Oceans	The Hydrostatic Equation	Latent Heats	Cloud Classification	The Atmospheric General Circulation
	SLO-2	The Cryosphere	Geopotential	Saturated Adiabatic and Pseudoadiabatic Processes	terminal velocity	The Kinetic Energy Cycle
S-3	SLO-1	The Terrestrial Biosphere	Scale Height and the Hypsometric Equation	The Saturated Adiabatic Lapse Rate	Microstructures of Warm Clouds	Atmospheric Boundary Layer and its structure
	SLO-2	Roles of Various Components of the Earth System in Climate	Thickness and Heights of Constant Pressure Surfaces	Equivalent Potential Temperature and Wet-Bulb Potential Temperature	Cloud Liquid Water Content and Entrainment	Estimation of Atmospheric Boundary Layer
S-4	SLO-1	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars
	SLO-2					
S-5	SLO-1	The Hydrologic Cycle	The First Law of Thermodynamics	Normand's Rule	Growth of Cloud Droplets in Warm Clouds : Growth by Condensation	Numerical Weather Prediction
	SLO-2	Its components	Joule's Law	Net Effects of Ascent Followed by Descent	Bridging the Gap between Droplet Growth by Condensation and Collision–Coalescence	Numerical Weather Prediction
S-6	SLO-1	Carbon Cycle	Specific Heats	Static Stability	Formation of Precipitation in Cold Clouds	Extratropical Cyclones : An Overview
	SLO-2	Carbon in the Atmosphere	Enthalpy	Unsaturated Air	Classification of Solid Precipitation	Fronts and Surface Weather
S-7	SLO-1	Carbon in the Biosphere	Adiabatic Processes	Saturated Air	Kinematics of the Large-Scale Horizontal Flow	Vertical Structure
	SLO-2	Carbon in the Oceans	Concept of an Air Parcel	Conditional and Convective Instability	Elementary Kinematic Properties of the Flow	Air Trajectories
S-8	SLO-1	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars
	SLO-2					
S-9	SLO-1	Solar Constant	The Dry Adiabatic Lapse Rate	Physics of Scattering and Absorption and Emission	Vorticity and Divergence	Orographic Effects : Rossby Wave Propagation along Sloping Terrain
	SLO-2	Incoming and outgoing radiation of earth	Derivation of Dry Adiabatic Lapse Rate	Scattering by Air Molecules and Particles	Deformation	Deep Convection : Structure and Evolution of Convective Storms

S-10	**SLO-1**	*Radiation Budget*	*Potential Temperature*	*Absorption by Particles*	*Dynamics of Horizontal Flow : Apparent Forces*	*Mesoscale Convective Systems*
	SLO-2	*Radiation Budget*	*Its derivation*	*Absorption and Emission by Gas Molecules*	*Real Forces*	*Mesoscale Convective Systems*
S-11	**SLO-1**	*Radiative Equilibrium*	*Thermodynamic Diagrams*	*Absorption and Emission of Infrared Radiation in Cloud-Free Air*	*The Horizontal Equation of Motion*	*Tropical Cyclones*
	SLO-2	*Temperature of planet Earth*	*Applications*	*Vertical Profiles of Radiative Heating Rate*	*The Geostrophic Wind*	*Structure, Thermodynamics, and Dynamics*
S-12	**SLO-1**	*Problems/Demos/*	*Problems/Demos/*	*Problems/Demos/*	*Problems/Demos/*	*Problems/Demos/*
	SLO-2	*Simulations/Seminars*	*Simulations/Seminars*	*Simulations/Seminars*	*Simulations/Seminars*	*Simulations/Seminars*

Learning Resources	1. John M Wallace and Peter V Hobbs, Atmospheric Science – An introductory Survey, International Geophysics Series, 2006 2. Murry L Salby, Fundamentals of Atmospheric Physics, International Geophysics Series, 1996.	3. Kshudiram Saha,The Earth's Atmosphere, Its Physics and Dynamics, Springer, 2008 4. C. Donald Ahrens, Essentials of Meteorology : An invitation to the atmosphere, Cengage Learning, 2010

Learning Assessment

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

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

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. D. Sivaprakasam, Scientist F, ARCI, Chennai	*Prof. B.S. Murthy, Director, IIT Hyderabad*	*Dr. A. Naga Rajesh, SRM IST*
Dr. Ajay Singh, BARC, Mumbai	*Prof. S Balakumar, University of Madras*	*Dr. T.V. Lakshmi Kumar, SRM IST*

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Course Code	UPY23D09J	Course Name	Symmetries and Fields	Course Category	D	Discipline Specific Elective Course	L	T	P	O	C
							3	0	2	2	4

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning 1	2	3
CLR-1 :	*understand the role of the discrete groups in mathematics and physics*			
CLR-2 :	*understand simple harmonic motion and central force motion*			
CLR-3 :	*understand intrinsic quantum numbers: spin and colour*			
CLR-4 :	*understand space-time symmetries*			
CLR-5 :	*understand the dynamics of relativistic fields*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*apply discrete symmetry groups to solve maths and physics problems*	2	75	60
CLO-2 :	*compute observable in vibrational and rotational systems using symmetries*	2	80	70
CLO-3 :	*solve problems for systems with spin and colour quantum numbers*	2	70	65
CLO-4 :	*compute problems of relativistic kinematics*	2	70	70
CLO-5 :	*write down lagrangians and equations of motion for scalar fields*	2	80	70

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

Duration (hour)		15	15	15	15	15
S-1	SLO-1	Definition of a group	Symmetries of tensors	The Lie Algebra of SU(N)	*Space Time Symmetries:* Four Vectors	The Action Functional: Real Scalar Field
	SLO-2	Abelian and Non-abelian groups	Young Diagrams	Generators of SU(N)	The Minkowski metric	Invariance of the Action Functional
S-2	SLO-1	Discrete groups	Characters	The fundamental representation of SU(N)	Lorentz Transformations	Natural Units
	SLO-2	Multiplication Tables	Character Tables	The adjoint representation of SU(N)	The Lorentz Group	Dimensional Analysis
S-3	SLO-1	Subgroups	Conjugacy Classes	The antisymmetric tensor	Generators of the Lorentz Group	Variation of the Action Functional
	SLO-2	Invariant subgroups	Classes as group Action	Tensor Products of SU(N) representations: How SU(2) is special	Algebra of SO(3,1)	Equations of Motion
S-4 to S-5	SLO-1	Problems/Demos/ Simulations/Seminars	Character Tables of Zn, Sn, An, Qn, and Dn	Spin from SU(2)	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars
	SLO-2					
S-6	SLO-1	Direct Product of groups	Invariants	Lie Algebra of SU(3)	The Cover of SO(3,1)	*Global Symmetries:* Noether's Theorem with Operators
	SLO-2	Semi-direct Products	Invariants for A_n and Z_n	Generators of SU(3)	Decomposition into SU(2)×SU(2)	Derivation
S-7	SLO-1	Group Action	Coverings	Structure Factors	Scalar representations of SO(3,1)	Lagrangian for a Complex Scalar Field: U(1)
	SLO-2	Examples using Discrete groups	Qn as the cover of Dn	Symmetry Coefficients	(½,0)+(0,½) representations	Conserved Charges
S-8	SLO-1	Cosets	Embeddings	SU(3) Representation	(½,½) representation	The Scalar Potential
	SLO-2	Finding cosets of groups	Embedding A_4 in S_4	Invariants	(1,0)+(0,1) representation	Minima of the potential
S-9 to S-10	SLO-1	Problems on Cosets	Problems/Demos/ Simulations/Seminars	SU(3) multiplication: Quarks and Gluons	Classification of Lorentz Transformations and CPT	The Stress-Energy Tensor
	SLO-2					
S-11	SLO-1	Factors	Lie Groups	Central Force Motion	Poincare Symmetry	Spontaneous Symmetry breaking (SSB)
	SLO-2	Factor Groups	Lie Algebras	Symmetries of Central Force Motion	The Poincare Algebra	SSB of a Discrete symmetry

S-12	**SLO-1**	Group representations	Rotations and the Lie algebra of SO(3)	The Laplace Runge-Lenz Vector	Wigner's Little Group: What is an elementary particle?	SSB of a continuous Abelian symmetry
	SLO-2	Irreducible and Inequivalent Representations	Generators of SO(3)	SO(4)	Wigner Classifications	Goldstone Bosons
S-13	**SLO-1**	Tensor Product Representations	Generators of Lie Groups	Decomposition of SO(4)	General Definition of a Lagrangian: Why Group Theory?	Two scalar Lagrangian: U(1) breaking and cosets
	SLO-2	Constructing higher dimensional representations from lower ones	Properties of Generators	Cover of SO(4)	Fields and Lagrangian densities	The remnant Zn
S-14 to S-15	**SLO-1**	Schur's Lemma, Great Orthogonality Theorem	Representations of SO(3)	Problems/Demos/ Simulations/Seminars	Problems on Poincare Symmetry and Little Groups	SSB of a continuous non-abelian symmetry.
	SLO-2					

Learning Resources	1.	Group Theory: A Physicist's Surve; P Ramond; Cambridge University Press (2010).	4. A Physicist's Introduction to Algebraic Structure; P Pal; Cambridge University Press (2022)
	2.	Field Theory: A Modern Primer, 2nd Edition; P Ramond; Sarat Book House (2007).	5. Group Theory In Physics; WK Tung; World Scientific (1985).
	3.	A Physicist's Introduction to Algebraic Structure; P Pal; Cambridge University Press (2022)	6. Group Theory in a Nutshell for Physicists; A Zee; Princeton University Press (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	30%	30%	30%	30%	30%	30%	30%	30%	30%	-
	Understand										
Level 2	Apply	40%	40%	50%	40%	50%	40%	50%	40%	50%	-
	Analyze										
Level 3	Evaluate	30%	30%	20%	30%	20%	30%	20%	30%	20%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

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

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
-	Prof Anirban Kundu, University of Calcutta, Kolkata, India.	Dr Triparno Bandyopadhyay, SRMIST
-	Dr Joydeep Chakrabortty, IIT Kanpur, Kanpur, India.	Dr. Rohit Dhir, SRMIST

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Course Code	UPY23D10J	Course Name	Advanced Condensed Matter Physics	Course Category	D	Discipline Specific Elective Course	L	T	P	O	C
							3	0	2	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1:	Understanding the physics of quantum phase transitions and quantum materials.			
CLR-2:	Provide quantitative knowledge of microscopic and phenomenological theory of superconductivity, superfluidity and magnetism.			
CLR-3:	Familiarize the students with the application of many body techniques to address quantum phases and phase transitions.			
CLR-4:	Introduce the students to the implementation of basic numerical techniques to address the physics of quantum materials.			
CLR-5:	Familiarize the students to the modern experimental techniques/probes used to study quantum materials			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO - 1	PSO - 2	PSO - 3
CLO-1:	Theoretically and numerically study quantum materials	2	80	75	H	H	-	-	H	-	-	-	-	H	-	-	-	-	-
CLO-2:	Understand quantum phase transitions.	2	80	70	H	M	-	-	H	-	-	-	-	H	-	-	-	-	-
CLO-3:	Acquire fundamental concepts of superconductivity, magnetism and superfluidity	2	75	70	H	H	H	H	H	M	-	H	H	H	-	M	-	-	-
CLO-4:	Numerically determine and predict the properties of quantum materials	2	80	75	H	H	H	-	H	M	H	H	H	H	-	M	-	-	-
CLO-5:	Pursue advanced research on quantum materials and many body systems.	2	80	70	H	H	H	-	H	M	H	H	H	H	-	M	-	-	-

Duration (hour)		15	15	15	15	15
S-1	SLO-1	Recap of classical and quantum statistics of particles, MB, FD, BE statistics of ideal gas	Local electric field at an atom, Lorentz field	Revisiting quantum mechanics, creation and annihilation of particles	Revisiting superconductivity:- Meissner effect, perfect conductivity, Heat capacity, Energy gap, Isotope effect	Single particle Tunneling
	SLO-2	Comparison of three distributions	Depolarizing field and factor	Introduction to second quantization	Penetration depth, coherence length	Josephson effect
S-2	SLO-1	Revisit Free electron theory of Fermi gas, Nearly free electron theory	Field of dipoles inside the cavity	Elements of second quantization	London theory	Superconducting Quantum Interference Device
	SLO-2	Revisit Bloch theorem, Kronig-Penny model, Umklapp scattering	Clausius-Mossotti relation	Langevin diamagnetic equation, Quantum theory of paramagnetism.	Magnetization versus field response of Type I and Type II superconductors	Experiments requiring large magnetic field: e.g., quantum Hall effect and,fractional quantum Hall effect
S-3	SLO-1	Band theory of solids	Derivation of Clausius-Mossotti relation	Ferromagnetism, Curie point and exchange integrals.	Magnetic flux lines & flux quantization	High Tc superconductors
	SLO-2	Classification of metal, insulator and semiconductor	Structural Phase Transition, Landau equation	Magnons and spin waves	Vortex state in type II superconductor, estimation of Hc1 and Hc2.	Cuprate based High Tc superconductors
S-4-5	SLO-1	Problem solving on free electron theory	Problem solving on Electric field	Discussion and doubt clearance on second quantization	Numerical implementation of Ising model.	Numerical implementation of BdG equations for a clean s-wave superconductor (inhomogeneous mean field theory)
	SLO-2					
S-6	SLO-1	Wave equation of electron in a periodic potential, Crystal momentum of an electron	Derivation of condition for 1st order phase transition	Ferrimagnetism, Anti-ferromagnetism	Ginzburg Landau theory in inhomogeneous system	AC and DC Josephson effect, Fabrication of Josephson junction

	SLO-2	Solution of central equation	Derivation of condition for 2nd order phase transition	Spin wave dispersion relation for anti-ferromagnets	Ginzburg-Landau equations	Superconducting magnets
S-7	**SLO-1**	Kronig Penney model in reciprocal space	Susceptibility versus temperature response for paraelectric material	Derivation of spin wave dispersion relation for anti-ferromagnets	Abrikosov vortex phase	Gauge symmetry and symmetry breaking
	SLO-2	Number of orbitals in a band, metal and insulator	Susceptibility versus temperature response for ferroelectric material	Magnetization versus field hysteresis	Structure of isolated vortex	Local gauge invariance
S-8	**SLO-1**	Origin of energy gap, Semiconductor crystals	Soft optical phonons, Polarization catastrophe	Susceptibility versus temperature response for dia, para and ferromagnetic materials	Vortex structure in unconventional superconductors.	Introduction to superfluidity
	SLO-2	Direct and indirect band gaps	Order-disorder transition	Susceptibility versus temperature response for antiferromagnetic materials	Elements of BCS theory	Non-interacting ideal Bose gas
S-9-10	**SLO-1**	Problems on band theory of solids	Examples of 1st and 2nd order phase transitions	Ferromagnetic domains	Numerical calculation of Abrikosov vortex lattice in conventional superconductors.	Ideal Bose gas in a trap, Bose Einstein Condensation
	SLO-2					
S-11	**SLO-1**	Intrinsic carrier concentration	Displacive transition	Domain wall	Cooper pair formation	Thermodynamic quantities:- Condensed phase, normal phase, specific heat.
	SLO-2	Intrinsic mobility and Impurity conductivity.	Ferroelectric domains and domain walls	Bloch wall and Neel wall	BCS wave function	Basic scattering theory and Feshbach resonance
S-12	**SLO-1**	Thermoelectric effects	Polarization versus field hysteresis loop	Magneto-crystalline Anisotropy, Shape Anisotropy	Predictions of the BCS theory	Gross-Pitaevskii equation
	SLO-2	Semimetals	Paraelectric phase, Anti-ferroelectricity	Magnetic models:- 1D Ising, 1D XY, 1D Heisenberg	The BCS energy gap and quasiparticle states	Derivation of Gross-Pitaevskii equations.
S-13	**SLO-1**	Fermi surface and metals	Order parameter	Magnetic models:- 2D Ising, 2D Heisenberg	Variational method for BCS theory	Dynamics of condensate and time dependent Gross - Pitaevskii equations
	SLO-2	construction of Fermi surfaces of nearly free electrons	Variation of order parameter with temperature	Experimental imaging of magnetic domain	Variational method for BCS theory	Time dependent Gross-Pitaevskii equations
S-14 to 15	**SLO-1**	Discussion on Fermi surface	Discussion on phase transition.	Experimental measurement of magnetization	Bogoliubov-de-Gennes of superconductivity and BdG equations	Numerical implementation of time dependent Gross-Pitaevskii equations.
	SLO-2					

Learning Resources	1. Introduction to solid state physics (Charles Kittle) 2. Basic aspects of the quantum theory of solids: order and elementary excitations (Daniel I. Khomskii, Cambridge University Press.) 3. Introduction to superconductivity, (M. Tinkham, McGraw-Hill publications)	4. Superconductivity of metals and alloys (P. G. De Gennes, Westview Press, Advanced Book Program) 5. Bose-Einstein Condensation of dilute gases (C. J. Pethick and H. Smith, Cambridge University Press.) 6. Superconductivity, Superfluids and Condensates, James F Annet, Oxford University Press, May 2003.

Learning Assessment

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

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

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. R Seshadri, Titan Company Limited, seshadri@titan.co.in	Prof. Rajesh Narayanan, Department of Physics, IITM	Dr. Madhuparna K, SRMIST
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Course Code	UPY23G08T	Course Name	Applications of Nanotechnology	Course Category	G	Generic Elective Course	L	T	P	O	C
							3	1	0	2	4

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

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

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

		Program Learning Outcomes (PLO)														
		1 Fundamental Knowledge	2 Application of Concepts	3 Link with Related Disciplines	4 Procedural Knowledge	5 Skills in Specialization	6 Ability to Utilize Knowledge	7 Skills in Modeling	8 Analyze, Interpret Data	9 Investigative Skills	10 Problem Solving Skills	11 Communication Skills	12 Analytical Skills	13 PSO -1	14 PSO -2	15 PSO-3
CLO-1 :	determine the nanotechnology and actual working areas and applications.	H	H								H					
CLO-2 :	classify different techniques for synthesis of nanomaterials	H	H								H					
CLO-3 :	classify different techniques depending on the application areas	H	H								H					
CLO-4 :	determine the characterization techniques for nanomaterials	H	H								H					
CLO-5 :	discuss and evaluate state-of-the-art characterization methods for nanomaterials	H	H								H					

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Nanotechnology	Classification of nanostructures	Top-down approach	Characterization techniques	Application od nanotechnology
	SLO-2	History and importance	zero, one, two and three dimensional nanostructures,	overview	General Introduction	Nanotechnology in food, FDA regulation
S-2	SLO-1	opportunity at the nanoscale,	What is density of states (DOS)? How DOS changes with dimensional nanostructures	bottom-up approach	Scanning electron microscope (SEM), transmission electron microscope (TEM), comparing SEM, TEM and SPM for different classes of nanomaterials.	Nanoemulsions, Methods of producing nanoemulsions
	SLO-2	Examples	Quantum confinement effect	Overview with examples	scanning electron microscope (SEM) Qualitative Overview	Nanotechnology to enhance food safety and quality
S-3	SLO-1	length and time scale in structures,	Confinement effect with different nanostrcture	method of nanomaterials preparation,	transmission electron microscope (TEM),	Intelligent materials for packaging
	SLO-2	Definitions and concepts	size dependency in nanostructures, Examples	Qualitative discussion	Qualitative Overview	Examples
S-4	SLO-1	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars
	SLO-2					
S-5	SLO-1	length and time scale in structures,	Confinement effect with different nanostrcture	method of nanomaterials preparation,	transmission electron microscope (TEM),	Intelligent materials for packaging
	SLO-2	Definitions and concepts	size dependency in nanostructures, Examples	Qualitative discussion	Qualitative Overview	Examples
S-6	SLO-1	difference between bulk and nanoscale materials	quantum size	wet chemical routes of synthesis	scanning probe microscope (SPM),	Nanomedicine
	SLO-2	Examples	Concept	physical routes	Qualitative Overview	Interaction of nanoparticles with Biological barriers
S-7	SLO-1	Significance of Nano size	Quantum size effects in nanostructures,	physical vapor deposition (PVD)	comparing SEM, TEM and SPM	Respiratory path, Gastrointestinal absorption and Skin absorption of nanoparticles
	SLO-2	Examples	Examples	What is Plasma? Plasma Components and ionization, DC Plasma	Basic differences	Nanoparticle concentration determination: dose matters

S-8	**SLO-1**	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2					
S-9	**SLO-1**	*properties at nanoscale*	*chemistry of tailored nano shapes*	*Mean free path of atom/molecule in a chamber*	*Application of Discussed techniques*	*Nanostructures for water and wastewater treatment*
	SLO-2	*optical,*	*Qualitative discussion*	*Sputtering, atoms sputter from target*	*Overview*	*Construction of membranes and characteristics*
S-10	**SLO-1**	*Electronic properties*	*quantum dots*	*DC and RF sputtering difference, why need AC plasma?*	*different classes of nanomaterials*	*Types of Adsorption, Surface area and pore size*
	SLO-2	*Magnetic Properties*	*nanowells*	*chemical vapor deposition (CVD) and Mass flow controlled regime*	*Choice of Characterization Technique*	*Membrane Filtration and reverse osmosis, Membrane configurations*
S-11	**SLO-1**	*Chemical Properties*	*nanoribbons*	*CVD reaction mechanism, homogenous process and heterogeneous process*	*SEM, TEM and SPM*	*Nanotechnology in storage devices*
	SLO-2	*Overview*	*nanowires*	*Growth rate dependence with gas flow rate and temperature*	*Using for different materials*	*Batteries and application*
S-12	**SLO-1**	*Assignment on Properties*	*Problems/Demos/ Simulations/Seminars on above-given topics*	*Seminar on Synthesis*	*Assignment on Characterization*	*Assignment on applications*
	SLO-2					

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

Learning Assessment

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

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

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Dr. Krishna SurendraMuvvala, Saint Gobain Research India, India, Krishna.muvvala@saintgobain.com	Prof. V. Subramaniyam, IIT Madras, vsubbu@iitm.ac.in	Dr. Debabrata Sarkar, SRMIST

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

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

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

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

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Introduction to the subject of computational chemistry	Review of the variational method: definition and theorems	Electronic spin: S2 operator, degeneracy,	Introduction to analytic gradient: theory	Introduction to excited state theories used in computational chemistry: concept
	SLO-2	Scope of computational chemistry	Review of the variational method: derivation	evaluating the spin of Slater determinants	Applications of analytic gradient	Introduction to excited state theories used in computational chemistry: theory
S-2	SLO-1	The tools of computational chemistry: GUI	Hartree-Fock molecular orbital theory	Group theory: Molecular point groups	Electrostatics	Excited states: methods
	SLO-2	The tools of computational chemistry: Simulation packages	Slater determinants, anti-symmetry principle	Group theory: term symbols	Applications of electrostatics	Excited states: applications
S-3	SLO-1	Introduction to molecular mechan-ics (MM)	Basis sets	Group theory: computational simplifications	Introduction to charge analysis	Introduction to solvation in computational chemistry: definitions
	SLO-2	comparison of popular force fields (MM)	EMSL basis set exchange	Group theory: application	different types of charges	Introduction to solvation in computational chemistry: theory
S-4	SLO-1	Practical session on GUI	Practical session on applying HF theory to evaluate single point energy of water	Practical session on applying group theory to small molecules	Practical session on charge analysis of molecules: Mullikan charge	Practical session on energy evaluation in gas phase
	SLO-2	Practical session on simulation packages	Practical session on applying HF theory to evaluate single point energy of ammonia	Practical session on applying group theory to cyclic structures	Practical session on charge analysis of molecules: Löwdin charge	Practical session on energy evaluation in solvent phase
S-5	SLO-1	Performance of molecular mechanics on biomolecules	Derivation of HF equations	Semiempirical methods	Transition state theory	Models of Solvation: PCM

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

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

Learning Assessment

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

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

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

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Course Code	UPY23P06L	Course Name	Project Phase - II	Course Category	P	Internship/Project	L	T	P	O	C
							0	0	12	2	6

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:	*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 physics*	
CLR-3:	*promote independent and collaborative research work in the domain of physics*	
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 physics*	

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:	*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
Project Phase-II	20%	30 %	30%	20 %

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

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

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

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

Duration (hour)		18	18	18	18	18
S-1	SLO-1	*Sources of conventional energy*	*Space lattice basis*	*Kinetic theory of gases*	*Electric charge - conservation of charge, Permittivity*	*Time period - amplitude - phase*
	SLO-2	*Need for non - conventional energy resources*	*Unit Cell, lattice parameters*	*Ideal gas laws*	*Coulomb's law*	*Wave nature of light*
S-2	SLO-1	*Solar energy and solar cells and its applications*	*Two dimensional and three dimensional Bravais lattices*	*Van Der Waal's equation of states*	*Electric field*	*Huygens's principle*
	SLO-2	*Bio mass energy*	*The seven crystal systems*	*Derivation of Van Der Waal's equation of states*	*Electric potential*	*Interference and Coherence*
S-3	SLO-1	*Generation and applications of bio mass energy*	*Cubic crystal system and symmetry*	*Pressure of an ideal gas*	*Gauss's law*	*Young's double slit experiment*
	SLO-2	*Wind energy generation and applications*	*Reciprocal lattice and its importance*	*Derivation of Pressure of an ideal gas*	*Applications of Gauss's law*	*Interference from thin films*
S-4 to S-6	SLO-1	*Introduction to the Lab experimentation*	*Calculation of lattice cell parameters by X-ray diffraction*	*Determination of specific heat capacity of the liquid by Newtons's law of cooling*	*Calibration of Voltmeter using potentiometer*	*Determination of dispersive power of a prism using spectrometer*
	SLO-2					
S-7	SLO-1	*Nuclear energy - Atomic structure*	*Density and atomic packing fraction*	*Laws of thermodynamics*	*Conductors and dielectrics*	*Michelson's interferometer*
	SLO-2	*Alpha, beta and gamma radiation*	*Crystal directions and planes*	*Entropy*	*Electric Current*	*Diffraction - Wave theory of light*
S-8	SLO-1	*Law of radioactive decay, Decay constant*	*Introduction to Miller indices*	*Change of entropy in reversible processes*	*Ohm's law*	*Light and Optics*
	SLO-2	*Half-life and mean life*	*Interplanar distance*	*Change of entropy in irreversible processes*	*Magnetic induction*	*Fermat's principle*
S-9	SLO-1	*Nuclear energy*	*Hexagonal closely packed (HCP) structure*	*Low temperature*	*Permeability and susceptibility*	*Laws of reflection and refraction*
	SLO-2	*Applications of nuclear energy*	*Derivation of HCP atomic packing fraction*	*Joule - Kelvin effect-introduction*	*Numerical Problems/Demos/ Simulations/Seminars on Permeability and susceptibility*	*Total internal reflection*
S-10 to S-12	SLO-1	*Study of the I-V Characteristic of a Solar Cell*	*Dielectric constant Measurement*	*Determination of thermal conductivity of a bad conductor using Lee's disc method*	*Calibration of Ammeter using potentiometer*	*Study of attenuation and propagation characteristics of optical fiber cable*
	SLO-2					
S-13	SLO-1	*Mass defect*	*Diamond crystal structure*	*J-K effect- theory*	*Magnetic field due to a current carrying conductor-Biot-Savart's law*	*Mirrors and lenses*

	SLO-2	*Nuclear binding energy*	*Derivation of APF for diamond structure*	*Applications of J-K effect*	*Ampere's circuital law*	*Lens makers formula*
S-14	**SLO-1**	*Fission reaction*	*X-ray diffraction*	*Linde's process*	*Faraday's law*	*Defects of images*
	SLO-2	*Evaluating nuclear energy generation by fission reaction*	*Problems/Demos/ Simulations/Seminars on X-ray diffraction*	*H, He, Nitrogen gas liquefaction*	*P and N type semiconductors*	*Coma distortion*
S-15	**SLO-1**	*Fusion reaction*	*Single crystal diffraction*	*Adiabatic demagnetization- introduction*	*Junction Diode*	*Spherical aberration in lenses*
	SLO-2	*Fusion energy cycles*	*powder diffraction*	*Working principle of adiabatic demagnetization-*	*Characteristics of Junction Diode*	*Chromatic aberration in lenses*
S-16 to S - 18	**SLO-1**	*Hall effect- Hall coefficient determination*	*Revision class for experiments*	*Determination of specific heat capacity of the liquid by Joule's calorimeter method*	*Band gap determination using Post Office Box – Specific resistance*	*Revision class for experiments*
	SLO-2					

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

Learning Assessment

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

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

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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SRM INSTITUTE OF SCIENCE AND TECHNOLOGY
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COURSES FOR EARNING ADDITIONAL CREDITS

Courses for Earning Additional Credits

Semester - II

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

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

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

		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 :	allow individuals to gain valuable experience and develop skills in a real-world setting.	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	ICT Skills	Leadership Skills	Life Long Learning
CLR-2 :	focus on developing skills that are directly applicable to a specific industry or trade																		
CLR-3 :	work closely with experienced professionals for guidance, support, and knowledge transfer.																		
CLR-4 :	combine practical training with theoretical knowledge and provide a solid foundation for long-term career growth and development.																		
CLR-5 :	provide individuals with a competitive edge in the job market																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	obtain insights and gain an in-depth understanding of both the industry and the specific organization or company	3	80	70	L	H	M	H	L	M	L	L	L	L	L	H	M	L	L
CLO-2 :	develop essential skills and knowledge that hold significant value for professional development.	3	85	75	M	H	H	M	L	M	L	L	M	L	L	H	M	L	L
CLO-3 :	navigate industrial platforms and essential tools, foster adaptability and enhance their professional literacy skills	3	75	70	M	H	M	H	L	M	M	L	M	L	M	H	M	L	L
CLO-4 :	gain confidence, practical experience, improve their problem-solving abilities, and develop a strong work ethic	3	85	80	M	H	M	H	L	M	M	L	M	L	M	H	M	L	L
CLO-5 :	increase their chances of securing employment or advancing in their chosen career.	3	85	75	H	H	M	H	L	M	M	M	M	L	M	M	M	L	L

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

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

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

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

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

CLR-1 :	*produce competent, creative and imaginative graduates with a strong scientific acumen*	1	2	3
CLR-2 :	*apply of the acquired knowledge, skills, and tools pertinent to the field of physics*			
CLR-3 :	*promote independent and collaborative research work in the domain of physics*			
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 physics*			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	ICT Skills	Leadership Skills	Life Long Learning
CLO-1 :	*demonstrate the key areas of research*	3	80	70	L	H	M	H	L	M	L	L	L	L	L	H	M	L	L
CLO-2 :	*develop laboratory and experiment related skills*	3	85	75	M	H	H	M	L	M	L	L	M	L	L	H	M	L	L
CLO-3 :	*posses' competence on data collection and process of scientific documentation*	3	75	70	M	H	M	H	L	M	M	L	M	L	M	H	M	L	L
CLO-4 :	*gain the knowledge of research ethics*	3	85	80	M	H	M	H	L	M	M	L	M	L	M	H	M	L	L
CLO-5 :	*solve problems in their area of research*	3	85	75	H	H	M	H	L	M	M	M	M	L	M	M	M	L	L

Students can choose problems of their own interest to develop software package using the programming languages/tools available. There will be two reviews conducted during the project period for all the students .At the end of the project, every student shall submit a structured project report and will take a Viva Voce examination.

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

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

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

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

		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	ICT Skills	Leadership Skills	Life Long Learning
CLR-1 :	allow individuals to gain valuable experience and develop skills in a real-world setting.																		
CLR-2 :	focus on developing skills that are directly applicable to a specific industry or trade																		
CLR-3 :	work closely with experienced professionals for guidance, support, and knowledge transfer.																		
CLR-4 :	combe practical training with theoretical knowledge and provide a solid foundation for long-term career growth and development.																		
CLR-5 :	provide individuals with a competitive edge in the job market																		
CLO-1 :	obtain insights and gain an in-depth understanding of both the industry and the specific organization or company	3	80	70	L	H	M	H	L	M	L	L	L	L	L	H	M	L	L
CLO-2 :	develop essential skills and knowledge that hold significant value for professional development.	3	85	75	M	H	H	M	L	M	L	L	M	L	L	H	M	L	L
CLO-3 :	navigate industrial platforms and essential tools, foster adaptability and enhance their professional literacy skills	3	75	70	M	H	M	H	L	M	M	L	M	L	M	H	M	L	L
CLO-4 :	gain confidence, practical experience, improve their problem-solving abilities, and develop a strong work ethic	3	85	80	M	H	M	H	L	M	M	L	M	L	M	H	M	L	L
CLO-5 :	increase their chances of securing employment or advancing in their chosen career.	3	85	75	H	H	M	H	L	M	M	M	M	L	M	M	M	L	L

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

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

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

Semester - IV

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

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

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

		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 :	*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 physics*																		
CLR-3 :	*promote independent and collaborative research work in the domain of physics*																		
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 physics*																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	ICT Skills	Leadership Skills	Life Long Learning
CLO-1 :	obtain insights and gain an in-depth understanding of both the industry and the specific organization or company	3	80	70	L	H	M	H	L	M	L	L	L	L	L	H	M	L	L
CLO-2 :	develop essential skills and knowledge that hold significant value for professional development.	3	85	75	M	H	H	M	L	M	L	L	M	L	L	H	M	L	L
CLO-3 :	navigate industrial platforms and essential tools, foster adaptability and enhance their professional literacy skills	3	75	70	M	H	M	H	L	M	M	L	M	L	M	H	M	L	L
CLO-4 :	gain confidence, practical experience, improve their problem-solving abilities, and develop a strong work ethic	3	85	80	M	H	M	H	L	M	M	L	M	L	M	H	M	L	L
CLO-5 :	increase their chances of securing employment or advancing in their chosen career.	3	85	75	H	H	M	H	L	M	M	M	M	L	M	M	M	L	L

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

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

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

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

		1	2	3
		Level of Thinking	Expected Proficiency	Expected Attainment
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 physics*			
CLR-3 :	*promote independent and collaborative research work in the domain of physics*			
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 physics*			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking	Expected Proficiency	Expected Attainment	Fundamental	Application of Concepts	Link with Related	Procedural Knowledge	Skills in Specialization	Ability to Utilize	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	ICT Skills	Leadership Skills	Life Long Learning
CLO-1 :	*demonstrate the key areas of research*	3	80	70	L	H	M	H	L	M	L	L	L	L	L	H	M	L	L
CLO-2 :	*develop laboratory and experiment related skills*	3	85	75	M	H	H	M	L	M	L	L	M	L	L	H	M	L	L
CLO-3 :	*posses' competence on data collection and process of scientific documentation*	3	75	70	M	H	M	H	L	M	M	L	M	L	M	H	M	L	L
CLO-4 :	*gain the knowledge of research ethics*	3	85	80	M	H	M	H	L	M	M	L	M	L	M	H	M	L	L
CLO-5 :	*solve problems in their area of research*	3	85	75	H	H	M	H	L	M	M	M	M	L	M	M	M	L	L

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

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

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

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

		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 :	*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 physics*																		
CLR-3 :	*promote independent and collaborative research work in the domain of physics*																		
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 physics*																		

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	ICT Skills	Leadership Skills	Life Long Learning
CLO-1 :	obtain insights and gain an in-depth understanding of both the industry and the specific organization or company	3	80	70	L	H	M	H	L	M	L	L	L	L	L	H	M	L	L
CLO-2 :	develop essential skills and knowledge that hold significant value for professional development.	3	85	75	M	H	H	M	L	M	L	L	M	L	L	H	M	L	L
CLO-3 :	navigate industrial platforms and essential tools, foster adaptability and enhance their professional literacy skills	3	75	70	M	H	M	H	L	M	M	L	M	L	M	H	M	L	L
CLO-4 :	gain confidence, practical experience, improve their problem-solving abilities, and develop a strong work ethic	3	85	80	M	H	M	H	L	M	M	L	M	L	M	H	M	L	L
CLO-5 :	increase their chances of securing employment or advancing in their chosen career.	3	85	75	H	H	M	H	L	M	M	M	M	L	M	M	M	L	L

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