ACADEMIC CURRICULA

UNDERGRADUATE DEGREE PROGRAMME

Bachelor of Science

(B.Sc. Physics)

Three Years

Learning Outcomes Based Curriculum framework (LOCF)

Academic Year

2020 - 2021

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

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

Kattankulathur- 603203, Chengalpattu District, 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-empowering 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 in Physics
PSO - 3	Graduates will be prepared to acquire a range of general skills, to solve problems, to evaluate information, to use computers productively, to communicate with society effectively and learn 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	M	H	H	H
PEO - 2	H	H	H	M	M
PEO - 3	H	H	H	H	L
PEO - 4	H	H	H	H	M
PEO - 5	H	H	M	M	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. Professional Core Courses (C)
(12 Courses)

Course Code	Course Title	Hours/ Week			
		L	T	P	C
UPY20101J	Properties of Matter and Acoustics	4	0	4	6
UPY20102T	Classical Mechanics and Relativity	4	2	0	6
UPY20201J	Electricity and Magnetism	4	0	4	6
UPY20202T	Mathematical Physics	4	2	0	6
UPY20301J	Heat and Thermodynamics	4	0	4	6
UPY20302T	Quantum Mechanics	4	2	0	6
UPY20303J	Analog and Digital Electronics	4	0	4	6
UPY20401J	Solid State Physics	4	0	4	6
UPY20501J	Modern Optics	4	0	4	6
UPY20502T	Statistical Mechanics	4	2	0	6
UPY20601T	Atomic Physics and Spectroscopy	4	2	0	6
UPY20602T	Nuclear Physics	4	2	0	6
Total Learning Credits					**72**

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

Course Code	Course Title	Hours/ Week			
		L	T	P	C
UPY20D01T	Elements of Earth's Atmosphere	4	2	0	6
UPY20D02T	Solar Technology				
UPY20D03T	Low Temperature Physics				
UPY20D04J	Computational Physics	4	0	4	6
UPY20D05J	Elements of Nanoscience and Nanotechnology				
UPY20D06J	Semiconductor Device Physics				
UPY20D07T	Radiation Physics	4	2	0	6
UPY20D08T	Plasma Physics				
UPY20D09T	Astrophysics				
UPY20D10L	Project Work	0	0	12	6
Total Learning Credits					**24**

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

Course Code	Course Title	Hours/ Week			
		L	T	P	C
ULT20G01J	Tamil-I	2	0	2	3
ULH20G01J	Hindi-I				
ULF20G01J	French -I				
ULT20G02J	Tamil-II	2	0	2	3
ULH20G02J	Hindi-II				
ULF20G02J	French -II				
UMA20A01T	Allied Mathematics-I	3	0	0	3
UMA20A02T	Allied Mathematics-II	3	0	0	3
UCY20A03J	Allied Chemistry	4	0	4	6
Total Learning Credits					**18**

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

Course Code	Course Title	Hours/ Week			
		L	T	P	C
UCD20S01L	Soft Skills	0	0	2	1
UPY20S01T	Digital Signal Processing	0	2	0	2
UPY20S02T	Atmospheric Observations				
UCD20S02L	Quantitative aptitude and reasoning	0	0	2	1
UPY20S03L	Electronic Instrumentation	0	0	4	2
UPY20S04L	Workshop Practice				
UMI20S01L	My India Project	0	0	0	1
UPY20S05L	Computer Programming with MATLAB	0	0	4	2
UPY20S06L	Microprocessors and Microcontrollers				
Total Learning Credits					**9**

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

Course Code	Course Title	Hours/ Week			
		L	T	P	C
ULE20AE1T	English	4	0	0	4
UES20AE1T	Environmental Studies	3	0	0	3
Total Learning Credits					**7**

6. Life Skill Courses (Jeevan Kaushal) (JK)
(4 Courses)

Course Code	Course Title	Hours/ Week			
		L	T	P	C
UJK20201L	Communication Skills	0	0	4	2
UJK20301T	Universal Human Values	2	0	0	2
UJK20401T	Professional Skills	2	0	0	2
UJK20501T	Leadership and Management Skills	2	0	0	2
Total Learning Credits					**8**

7. Extension activity (NS/NC/NO/YG)(EA)
(1 Course)

Course Code	Course Title	Hours/ Week			
		L	T	P	C
UNS20201L	NSS	0	0	0	0
UNC20201L	NCC				
UNO20201L	NSO				
UYG20201L	YOGA				
Total Learning Credits					**0**

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

8. Implementation Plan

Semester – I

Code	Course Title	Hours/ Week L	T	P	C
ULT20G01J	Tamil-I	2	0	2	3
ULH20G01J	Hindi-I				
ULF20G01J	French-I				
ULE20AE1T	English	4	0	0	4
UPY20101J	Properties of Matter and Acoustics	4	0	4	6
UPY20102T	Classical Mechanics and Relativity	4	2	0	6
UMA20A01T	Allied Mathematics-I	3	0	0	3
UPY20S01T	Digital Signal Processing	0	2	0	2
UPY20S02T	Atmospheric Observations				
UCD20S01L	Soft Skills	0	0	2	1
Total Learning Credits					25
Total number of hours /week					29

Semester – II

Code	Course Title	Hours/ Week L	T	P	C
ULT20G02J	Tamil-II	2	0	2	3
ULH20G02J	Hindi-II				
ULF20G02J	French-II				
UPY20201J	Electricity and Magnetism	4	0	4	6
UPY20202T	Mathematical Physics	4	2	0	6
UMA20A02T	Allied Mathematics-II	3	0	0	3
UCD20S02L	Quantitative Aptitude and Reasoning	0	0	2	1
UJK20201L	Communication Skills	0	0	4	2
UNS20201L	NSS	0	0	0	0
UNC20201L	NCC				
UNO20201L	NSO				
UYG20201L	YOGA				
Total Learning Credits					21
Total number of hours /week					27

Semester – III

Code	Course Title	Hours/ Week L	T	P	C
UPY20301J	Heat and Thermodynamics	4	0	4	6
UPY20302T	Quantum Mechanics	4	2	0	6
UPY20303J	Analog and Digital Electronics	4	0	4	6
UPY20D01T	Elements of Earth's Atmosphere	4	2	0	6
UPY20D02T	Solar Technology				
UPY20D03T	Low Temperature Physics				
UJK20301T	Universal Human Values	2	0	0	2
Total Learning Credits					26
Total number of hours /week					30

Semester - IV

Code	Course Title	Hours/ Week L	T	P	C
UPY20401J	Solid State Physics	4	0	4	6
UPY20D04J	Computational Physics	4	0	4	6
UPY20D05J	Elements of Nanoscience and Nanotechnology				
UPY20D06J	Semiconductor Device Physics				
UCY20A03J	Allied Chemistry	4	0	4	6
UPY20S03L	Electronic Instrumentation	0	0	4	2
UPY20S04L	Workshop Practice				
UMI20S01L	My India Project	0	0	0	1
UJK20401T	Professional Skills	2	0	0	2
Total Learning Credits					23
Total number of hours /week					30

Semester –V

Code	Course Title	Hours/ Week L	T	P	C
UPY20501J	Modern Optics	4	0	4	6
UPY20502T	Statistical Mechanics	4	2	0	6
UPY20D07T	Radiation Physics	4	2	0	6
UPY20D08T	Plasma Physics				
UPY20D09T	Astrophysics				
UPY20S05L	Computer Programming with MATLAB	0	0	4	2
UPY20S06L	Microprocessors and Microcontrollers				
UES20AE1T	Environmental Studies	3	0	0	3
UJK20501T	Leadership and Management Skills	2	0	0	2
Total Learning Credits					25
Total number of hours /week					29

Semester - VI

Code	Course Title	Hours/ Week L	T	P	C
UPY20601T	Atomic Physics and Spectroscopy	4	2	0	6
UPY20602T	Nuclear Physics	4	2	0	6
UPY20D10L	Project Work	0	0	12	6
Total Learning Credits					18
Total number of hours /week					24

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
UPY20101J	*Properties of Matter & Acoustics*	H	H	H	H	H	H	H	H	H	H	M	H	L	H	H
UPY20102T	*Classical Mechanics and Relativity*	H	H	H	H	H	H	H	H	H	H	M	H	L	H	H
UPY20201J	*Electricity and Magnetism*	H	H	H	H	H	H	H	H	H	H	M	H	L	H	H
UPY20202T	*Mathematical Physics*	H	H	H	M	H	H	M	H	H	H	M	H	L	H	H
UPY20301J	*Heat & Thermodynamics*	H	H	H	H	H	H	M	H	H	H	M	H	L	H	H
UPY20302T	*Quantum Mechanics*	H	H	H	M	H	H	M	H	H	H	M	H	L	H	H
UPY20303J	*Analog and Digital Electronics*	H	H	H	H	H	H	H	H	H	H	M	H	L	H	H
UPY20401J	*Solid State Physics*	H	H	H	H	H	H	H	H	H	H	M	H	M	H	H
UPY20501J	*Modern Optics*	H	H	H	H	H	H	H	H	H	H	M	H	L	H	H
UPY20502T	*Statistical Mechanics*	H	H	H	M	H	H	H	H	H	H	M	H	L	H	H
UPY20601T	*Atomic Physics and Spectroscopy*	H	H	H	H	H	H	H	H	H	H	M	H	L	H	H
UPY20602T	*Nuclear Physics*	H	H	H	M	H	H	H	H	H	H	M	H	L	H	H
UPY20D01T	*Elements of Earth's Atmosphere*	H	H	H	H	H	H	H	H	H	H	H	H	M	H	H
UPY20D02T	*Solar Technology*	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
UPY20D03T	*Low Temperature Physics*	H	H	H	H	H	H	H	H	H	H	M	H	H	H	M
UPY20D04J	*Computational Physics*	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
UPY20D05J	*Elements of Nanoscience and Nanotechnology*	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
UPY20D06J	*Semiconductor Device Physics*	H	H	H	H	H	H	H	H	H	H	M	H	M	H	H
UPY20D07T	*Radiation Physics*	H	H	M	M	M	H	H	H	H	H	M	H	M	M	M
UPY20D08T	*Plasma Physics*	H	H	H	M	H	H	H	H	H	H	H	H	H	H	H
UPY20D09T	*Astrophysics*	H	M	H	L	H	H	H	H	H	H	M	H	H	H	H
UPY20D10L	*Project Work*	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
ULT20G01T	*Tamil-I*	H	H	H	M	H	H	M	H	H	H	H	H	M	H	H
ULH20G01T	*Hindi-I*	H	H	H	M	H	H	M	H	M	H	H	H	H	H	H
ULF20G01T	*French-I*	H	H	H	H	H	H	M	H	H	H	H	H	H	H	H
ULT20G02T	*Tamil-II*	H	H	H	M	H	H	M	H	H	H	H	H	M	H	H
ULH20G02T	*Hindi-II*	H	H	M	H	H	H	H	H	M	H	H	H	M	H	H
ULF20G02T	*French –II*	H	H	M	H	H	H	H	H	M	H	H	H	M	H	H
UMA20A01T	*Allied Mathematics-I*	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
UMA20A02T	*Allied Mathematics-II*	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
UCY20A01J	*Allied Chemistry*	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
UCD20S01L	*Soft Skills*	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
UPY20S01T	*Digital Signal Processing*	H	H	H	H	H	H	M	H	H	M	L	H	L	M	H
UPY20S02T	*Atmospheric Observations*	H	H	H	H	H	H	M	H	H	H	L	H	M	M	H
UCD20S02L	*Quantitative aptitude and logical reasoning*	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
UPY20S03L	*Electronic Instrumentation*	H	H	H	H	H	H	H	H	M	H	L	M	H	M	H
UPY20S04L	*Workshop Practice*	H	H	H	H	H	H	M	H	H	H	L	H	H	M	H
UMI20401L	*My India Project*	H	H	M	M	M	H	H	M	H	H	H	M	M	H	H
UPY20S05L	*Computer Programming with MATLAB*	H	H	H	H	H	H	H	H	H	H	L	H	H	M	H
UPY20S06L	*Microprocessors and Microcontrollers*	M	H	H	H	H	H	H	H	H	H	M	H	H	H	H
ULE20AE1T	*English*	H	H	H	H	H	H	M	H	H	H	H	H	H	H	H
UES20AE1T	*Environmental Studies*	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
UJK20201L	*Communication Skills*	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
UJK20301T	*Universal Human Values*	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
UJK20401T	*Professional Skills*	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
UJK20501T	*Leadership and Management Skills*	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
	Program Average	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**

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

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) (6 credit /Course)	Discipline Specific Elective (DSE) (6 credits /Course)	Ability Enhancement Compulsory Courses (AECC) (4 credit/Course)	Life skills (Jeevan Kaushal) (2 credit /Course)	Skill Enhancement Course (SEC) (0&2 credit Courses)	Generic Elective (GEC)	Extension activity NCC/NSO/ NSS/YOGA	Total Credits
Sem I	CC-1(6) CC-2 (6)	-	AECC-1(4) (*English)*		SEC-1(2) SEC-2 (1) (*Soft skills*)	GE-1 (3) (*Language*-I) GE-2(3) (*Mathematics*-I)		**25**
Sem II	CC-3(6) CC-4 (6)	-	-	JK- 1(2) (*Communication Skills*))	SEC-3(1) *(Quantitative aptitude and reasoning)*	GE-3 (3) (*Language*-II) GE-4(3) (Mathematics-II)	NCC/NSO/ NSS/YOGA(0)	**21**
Sem III	CC-5(6) CC-6 (6) CC-7(6)	DSE-1(6)		JK-2 (2) *(Universal human values*				**26**
Sem IV	CC-8 (6)	DSE-2(6)		JK- 3 (2) *(Professional skills)*	SEC-4(2) SEC-5(1) *(My India project)*	GE-5(6) (*Chemistry*)		**23**
Sem V	CC-9(6) CC-10(6)	DSE-3(6)	AECC-3(3) (*EVS*)	JK – 4 (2) *(Leadership and Management skills)*	SEC-6(2)			**25**
Sem VI	CC-11(6) CC-12 (6)	DSE-4(6) (*Project*)						**18**
Total Credits	**72**	**24**	**7**	**8**	**9**	**18**	**0**	**138**

SEMESTER I

Course Code	ULT20G01J	Course Name	Tamil-I	Course Category	G	Generic Elective Course	L	T	P	C
							2	0	2	3

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*To enable them to learn the nuances of modern poetry in Tamil*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	To explore New historicism through the works of art written in Tamil to enlighten the students to understand the changes in the modern society			
CLR-3 :	Inculcate Ways of life, moralities and ethical factors as an essential part of learning Tamil literature			
CLR-4 :	Develop strategies of comprehension of texts of different origin			
CLR-5 :	Strengthen the language of the students both in oral and written			
CLR-6 :	Express their sentiments, emotions and opinions, reacting to information, situations			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	*Extend and expand their savoir-faire through the acquisition of skills to cater the needs of the modern era.*	*2*	*75*	*60*	*H*	*H*	*H*	*-*	*H*	*H*	*M*	*H*	*H*	*-*	*H*	*H*	*H*	*H*	*H*
CLO-2 :	Enable the students to appreciate their mother tongue and to Enhance their thinking capacity	*2*	*80*	*70*	*H*	*H*	*-*	*H*	*-*	*-*	*H*	*-*	*-*	*H*	*H*	*-*	*H*	*H*	*H*
CLO-3 :	Make them learn the basic rules of Language and make them communicate better	*2*	*70*	*65*	*H*	*H*	*H*	*M*	*-*	*-*	*H*	*-*	*-*	*H*	*H*	*-*	*H*	*H*	*H*
CLO-4 :	Develop strategies of comprehension of texts based on different culture and life styles	*2*	*70*	*70*	*H*	*-*	*H*	*H*	*H*	*-*	*M*	*-*	*-*	*H*	*H*	*-*	*H*	*H*	*H*
CLO-5 :	Strengthen spoken and written skills of the student	*2*	*80*	*70*	*-*	*H*	*-*	*M*	*-*	*H*	*H*	*-*	*-*	*H*	*H*	*-*	*H*	*H*	*H*
CLO-6 :	*Will be able to clear government examinations*	*2*	*75*	*70*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*

Duration (hour)		12	12	12	12	12
S-1	SLO-1	தமிழ்இலக்கியப்போக்குகள்	நவீனகவிதைதோற்றம்	தமிழரின்வீரமரபு	சிற்றிலக்கியத்தோற்றம்	மொழிவரலாறு
	SLO-2	இலக்கியநுட்பங்கள்	நவீனகவிதைவரலாறு	போர்விழுமியங்கள்	சிற்றிலக்கியவகைமை	மொழிப்பயிற்சி
S-2	SLO-1	தமிழ்க்கவிதைமரபு	நவீனகவிதைசெல்நெறிகள்	பரணிஅறிமுகம்	சிற்றிலக்கியங்கள்	தமிழும்அகராதியியலும்
	SLO-2	காலந்தோறும்கவிதை உள்ளடக்கம்	செல்நெறிகளில்கோட்பாடுகள்	பரணிஇலக்கியங்கள்	முதன்மைச்சிற்றிலக்கியங்கள்	அகரவரிசைப்படுத்தல்
S-3	SLO-1	காலந்தோறும்கவிதை வடிவம் –	கவிதைமொழி	கலிங்கத்துப்பரணி (484)	புதுக்கவிதையும்இதழ்களும்	கலைச்சொல்அறிமுகம்
	SLO-2	தற்காலஇலக்கியம்	நவீனகவிமொழியின்நுட்பங்கள்	தலைவனின்வீரம்	மணிக்கொடிஇதழ்	கலைச்சொல்உருவாக்கநுட்பங்கள்
S-4	SLO-1	புதுக்கவிதைஉருவாக்கம்	நவீனகவிஆளுமைகள்	தமிழ்இலக்கியமரபில்தூது	எழுத்துஇதழ்	தமிழில்கலைச்சொற்கள்
	SLO-2	புதுக்கவிதைசெல்நெறிகள்	நவீனகவிஆளுமைகளின்கவித்துவம்	தூதுஇலக்கியங்கள்	வானம்பாடிஇதழ்	நிலைபெற்றகலைச்சொற்கள்
S-5	SLO-1	பாரதியார் – காலத்தின்அடையாளம்	விளிம்புநிலைமனிதர்கள்	அழகர்கிள்ளைவிடுதூது (கண்ணிகள்)	சிறுகதைதோற்றம்	மரபுத்தொடர்
	SLO-2	பாரதியார் - பன்முகஆளுமை	விளிம்புநிலைஇலக்கியம்	தூதுமரபில்கிளியும்பாராட்டும்	சிறுகதைவளர்ச்சி	தமிழில்மரபுத்தொடர்கள்
S-6	SLO-1	பாரதியார் - கண்ணன்என்சேவகன்	ராஜாசந்திரசேகரரின்கைவிடப்பட்டகுழந்தை	செய்யுள்மரபில்கலம்பகம்	சிறுகதை – வரலாறு	நாட்டார்வழக்காறுகள்
	SLO-2	கண்ணன்என்சேவகன் கவிதைசொல்லும்வாழ்வியல்	புறக்கணிப்பும்வாழ்வியலும்	கலம்பகஇலக்கியங்கள்	சிறுகதைஆசிரியர்கள்	பழமொழிஅறிமுகம்
S-7	SLO-1	20 ஆம்நூற்றாண்டுக்கவிதைமரபில்பாரதிதாசன்	புலம்பெயர்தல்	நந்திக்கலம்பகம் (77)	புதினம்தோற்றம்	தமிழில்பழமொழிகள்
	SLO-2	பாரதிதாசனும்தமிழும்	புலம்பெயர்வாழ்வியல்	மகள்மறுத்தலில்வீரம்	புதினம்வளர்ச்சி	பழமொழியும்பயன்பாடும்
S-8	SLO-1	பாரதிதாசன் – தமிழினிஇனிமை,	அனார்– மேலும்சிலஇரத்தக்குறிப்புகள்	குறவஞ்சிஅறிமுகம்	புதினத்தின்வகைமை	தமிழ்இலக்கணநுட்பங்கள்
	SLO-2	தமிழின்பெருமையும்வளமையும்	உள்நாட்டுப்போர்ச்சூழலும்பெண்உளவியலும்	குறவஞ்சிஇலக்கியங்கள்	புதினஆசிரியர்கள்	இலக்கணமும்பயன்பாடும்
S-9	SLO-1	வானம்பாடியில்அப்துல்ரகுமான்	காலந்தோறும்பெண்	குற்றாலக்குறவஞ்சி (9)	அச்சுஊடகவரலாறு	தமிழில்சொல்வகைகள்

	SLO-2	அப்துல்ரகுமான்கவிதையின்தனித்தன்மைகள்	பெண்இலக்கியம்	மலையும்வாழ்வும்	அச்சுஊடகமும்தமிழும்	சொல்லும்பயன்பாடும்
S-10	SLO-1	அப்துல்ரகுமான் - அவதாரம்	சுகிர்தராணியின்அம்மா	காப்பியஇலக்கணம்	அச்சுஊடகமும்உரைநடைவளர்ச்சியும்	பெயர்ச்சொற்கள்
	SLO-2	அவதாரம்– நம்பிக்கையும்வெற்றியின்பாதைகளும்	பெண்மையும்தாய்மையும்	காப்பியவகைமைகள்	தமிழில்உரைநடை	பெயர்ச்சொற்கள்அறிதல்
S-11	SLO-1	சுற்றுச்சூழலியல்	சமத்துவம்	தமிழில்பௌத்தஇலக்கியங்கள்	சுவடிகள்	வினைச்சொற்கள்
	SLO-2	தமிழ்க்கவிதையில்சுற்றுச்சூழலியல்	பாலியல்சமத்துவம்	மணிமேகலை	சிவதருமோத்திரச்சுவடிபெற்றவரலாறு	வினைச்சொற்கள் அறிதல்
S-12	SLO-1	நரசிம்மன் – மகனேஎன்னைமன்னித்துவிடு	நா. முத்துக்குமாரின்தூர்கவிதை	பெண்சாபமும்காயசண்டிகையும்	புழங்குபொருள்பண்பாடும்தமிழர்வாழ்வியலும்	தமிழில்பெயரடை, வினையடை
	SLO-2	நவீனவாழ்வும்சுற்றுச்சூழலியல்அறிதலும்	தூர்கவிதைமுன்வைக்கும்பெண்சமத்துவம்	பெண்வரலாற்றில்சாபங்களின்கதைகள்	கூஜாவின்கோபம்	பெயரடை, வினையடைஅறிதல்

Learning Resources	1. குறிஞ்சித்தேன், தொகுப்பும்பதிப்பும் - தமிழ்த்துறைஆசிரியர்கள், எஸ்.ஆர்.எம். அறிவியல்மற்றும்தொழில்நுட்பக்கல்விநிறுவனம், காட்டாங்குளத்தூர், 603203, 2020 2. வல்லிக்கண்ணன், புதுக்கவிதைதோற்றமும்வளர்ச்சியும், ஆழிபதிப்பகம், சென்னை, 2018 3. கா. சிவத்தம்பி, தமிழில்சிறுகதைதோற்றமும்வளர்ச்சியும், என்.சி.பி.எச்., சென்னை, 2013 4. தமிழ்இணையக்கல்விக்கழகம் - http://www.tamilvu.org/ 5. மதுரைதமிழ்இலக்கியமின்தொகுப்புத்திட்டம் -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%	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	Expert from Higher Technical Institutions	Internal Experts
	Dr. R. Srinivasan, Associate Professor, Department of Tamil, Presidency College, Chennai,	*B.Jaiganesh, Assistant Professor & Head, FSH, SRMIST*
		T.R.HebzibahBeulahSuganthi, Assistant Professor, FSH, SRMIST
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Course Code	ULH20G01J	Course Name	Hindi-I	Course Category	G	Generic Elective Course	L	T	P	C
							2	0	2	3

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*To be able to converse well in the Hindi Language*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*To read and write and clarity*			
CLR-3 :	*To be willing listeners and translators –where need be*			
CLR-4 :	*To acquire the values/thought contents of the writers and practice in it in life.*			
CLR-5 :	*To find motivation through the various forms of literature and learn to overcome any challenges of life.*			
CLR-6 :	*To discover the importance of the language in making education as a means of growth in life and not mere literacy.*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*To appreciate the Hindi language in its various forms.*	*2*	*75*	*60*
CLO-2 :	*To understand the philosophy of life and living through stories.*	*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
H	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-
-	*H*	-	*H*	-	-	-	-	-	-	-	-	-	-	-

CLO-3 :	*To help the students learn and develop the fundamentals of life, through One-Act plays.*	*2*	*70*	*65*
CLO-4 :	*To share the richness of thought and content presented in the Hindi language, into other languages so that the readers would stand to gain.*	*2*	*70*	*70*
CLO-5 :	*To guide the students in the learning of the technical aspect of the Hindi language, this would help them in the field of administration.*	*2*	*80*	*70*
CLO-6 :	*To encourage the students to communicate with the public, on a large scale with the medium of Main stream and Documentary films.*	*2*	*75*	*70*

H	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
H	-	*H*	*H*	*H*	-	-	-	-	-	*H*	-	-	-	-
-	*H*	-	*H*	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		**12**	**12**	12	**12**	**12**
S-1	SLO-1	Kahani kya Hai	EkankiaurNatakkyahai	Patrkarita ka arambh	Film Samiksha	TaknikiShabdavali
	SLO-2	Jivan ka anubhav	Vidhyarthiyondonokeantar ko smajhkarapnedwara use prastutkarsaktahai	Vidhyarthiyon ka apnesamajkeprtijagrukta	Film ka prabhav ko smajhna	Vaigniktarike se bhashaon ka avishkaarkarna
S-2	SLO-1	Kahani keTatva	EKANKI KA ARTH	AazdiaurPatrkarita ka daiytava	SAMIKSHA KYA HAI	ARTH
	SLO-2	VishleshankarnekiKshmta	idhyarthikebhitarvishkleshankikshamtajagrit	Vidhyarthiyon ko patrkarita ka ihassmajkarsamajnirmankeliyesahyogdena	arkikvishleshankshmtapaidakartahai	Vidhyarthiuskearthdwara hi uskemahtavsmjhenge
S-3	SLO-1	Vo Tera Ghar Ye MeraGhar Parivar me BuzargonkeMahtav ko Samjhana	PARIBHASHA	PATRKARITA KA MAHTAVA	SAMIKSHA KE PRAKAR	PARIBHASHA
	SLO-2	BhartiyaSanskriti Se Vidhyarthiyon ko Jodna	Vidvanoke mat se parichay	atrkarita se bhut se sawal ka smadhan ho jatahai	Vidhyarthiyon ka un prkaro ka adhyaankarnajissevidhyarthi us samiksha ko tayaarkarpayenge	Vibhinnvidwanodwara di gai paribhasha se us baat ko smjhengevidhyathi
S-4	SLO-1	Mithaiwala PyarBantne se dukhkamhotahai	SWAROOP	PTRAKARITA KA ARTH	SAMIKSHA KA UDDESHYA	SHABDAVALI KI AVSHYAKTA
	SLO-2	Manavata ka Path	Vidhyarthiyon me iskisamajh se lekhankshmatabadegi	Vibhinnvidhvono ko padhne se vidhyarthiyonkitarkikkshmtabadhtihai ,	idhyarthikeandarsmajkeprati artavyabodhpaidahoga	Vaignikon ka awiskarkitnamahtavpurn
S-5	SLO-1	Bechadri Pal Chatro me Utsah Vardhan Karna	PATHYA VACHAN	PTRAKARITA KI PARIBHASHA	FILM KA SAMAJIK MAHTAVA	BHASHA VAIGYANIK
	SLO-2	Beta-betieksamankemahtav ko smjhana.	idhyarthiyon ka path kaushalbdhega	K vidhvaonokiuktieksmadhanbhihotahai	Samajikuttardaiytav ko smjhana	Bhasha vaignikonkijankari
S-6	SLO-1	Nadiaur Jeevan Paryavarankemahtav se awagatkarana.	PRASTUTI	PRAMUKH SAMACHAR PATR	FILM KA VISHLESHAN	KARYALYIN SHABD
	SLO-2	ManavJeevan me nadikiupyogitaaurMahtav.	Natakkhelne par bahut si taknikibatesamajhenge	Vidhyarthiyonkijankaribadhegi	idhyarthitarkikvishleshansikhega	habdkaisetayarkiyejatehainvidhyorthiyon ko jankari
S-7	SLO-1	PacheeschaukaDed Sau JamindariPratha se awagatkarana	MAHTVA	TV.PATRKARITA	DRISTIKON NIRMAN	ANGREZI SE HINDI ANUVAD
	SLO-2	AsprishyaVicharaokePratiSakaratamakBnana.	Natak ka mahtav ko smajhkrsamajkehitokesathjudna.	TV patrkarkedaiytav ko smajkarvidhyarthiiseapnerozgar se jodsaktahai	Vidhyarthi ka drishtikonnirmithoga	Hindi adhikaraiauranuvadakke pad keliyetayaarkarna
S-8	SLO-1	Kahani ka Uddeshya	PRASHAN-ABHYAS	PHOTO PATRKARITA	DOCUMENTRY FILM	HINDI SE ANGREZI ANUVAD
	SLO-2	Vidhyarthiyon ko Samaj se Joderakhna	Vidhyarthiyon ka lekhankshmataBadhna	Vidhyarthiyon me photo patrkaritakemahtav ka smajhpaidahona	Vidhyarthisamajikdharatalkikathinai ko smajhkardesh se judega	Hindi adhikariauranuvadakke pad keliyetayaarkarna.
S-9	SLO-1	Kahani Lekhan	UDDESHYA	PRASTUTIKARAN	MAIN STREAM FILM	EK DIN EK SHABD
	SLO-2	Vidhyarthi Ko likhnekiaurPreritkarna	Vidhyarthi ko smajupyoghitokijankaridena	Vidhyarthiapnibaatrakhnekikshmtavikstitkartahai	Vidhyarthion ko jivankeanchuepahluon se bhisakshaktkar	Vidhyarthiyon ko rozgaar se jodna
S-10	SLO-1	Seminar	PARICHARCHA	BHASHA-SHAILI	FILM KE DARSHAK	ATI MAHTVAPURN SHABD
	SLO-2	VidhyarthiyondwaraPrastutikaran	Vidhyarthi me vak-kaushalbdhana	Vidhyarthi ko apni report me bhasha-shaili ko sikhkarekbadhiya reporter ban saktahai	Vidhyarthiyon ka samajikgyan	habdonkemahtav ko smajhkar use yaadkarna
S-11	SLO-1	PrashanAbhyas	BHASHA SHAILI	PATRKARITA KE NIYAM	FILM AUR BAZAAR	SAMANYA SHABD AUR PARIBHASHIK SHABDAVALI ME ANTAR
	SLO-2	Vidhyarthiyon me Lekhn Kaushal kikshmataViksitkarna.	Vidhyarthiyon ko bhasha ka mahtavsmjhna	Vidhyarthiisesikhkareknyaypriyapatrkarban saktahai	Vidhyarthiyon ko rozgaar se jodna	Vidhyarthiyon ko vaighnikodwaratayaarki gai bhashakisamaj
S-12	SLO-1	Path-Punravarti	EKANKI AUR RANGMANCH	PATRKAR KA DAIYTVA	FILM DARSHAK KA MAHTAVA	PARIBHASHIK SHABDAVALI KA MAHTAV
	SLO-2	Parikshakeliye Saksham	Vidhyarthiisserangmanchkemahtav ko smajhenge	Vidhyarthiyon ko patrkar ka daityvasikhkarsmajkeuttardaityva ko nibhanahai	Vidhyarthiyon ko darshakkiruchiyon se awagatkarvana	Rozgaar se vidhyarthiyon ko jodnaw

Learning Resources	1. The Prescribe Text Book Compiled and Edited by Department of Hindi 2. *www.gadyakosh.com* 3. *www.shabdkosh.com*

Learning Assessment

	Bloom's Level of Thinking	**Continuous Learning Assessment (50% weightage)**								**Final Examination (50% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (20%)**		**CLA – 4 (10%)#**			
		Theory	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**
Level 1	Remember	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	**Expert from Higher Technical Institutions**	**Internal Experts**
	Prof.(Dr.) S.Narayan Raju, Head, Department of Hindi,CUTN, Tamilnadu	*Dr.SPreeti. Associate Professor & Head, SRMIST*
		Dr. Md.S. Islam Assistant Professor, SRMIST
		Dr. S. Razia Begum, Assistant Professor, SRM IST

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Course Code	**ULF20G01J**	**Course Name**	**French-I**	**Course Category**	*G*	**Generic Elective Course**	**L**	**T**	**P**	**C**
							2	**0**	**2**	**3**

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Extend and expand their savoir-faire through the acquisition of current scenario*
CLR-2 :	Enable the students to overcome the fear of speaking a foreign language and take position as a foreigner speaking French
CLR-3 :	Make them learn the basic rules of French Grammar.
CLR-4 :	Develop strategies of comprehension of texts of different origin
CLR-5 :	Strengthen the language of the students both in oral and written
CLR-6 :	Express their sentiments, emotions and opinions, reacting to information, situations

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	**Learning**		
		1	**2**	**3**
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*To acquire knowledge about French language*	*2*	*75*	*60*
CLO-2 :	*To strengthen the knowledge on concept, culture, civilization and translation of French*	*2*	*80*	*70*
CLO-3 :	*To develop content using the features in French language*	*2*	*85*	*75*
CLO-4 :	*To interpret the French language into other language*	*2*	*70*	*80*
CLO-5 :	*To improve the communication, intercultural elements in French language*	*2*	*80*	*70*
CLO-6 :				

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
H	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-
-	*H*	-	*H*	-	*H*	-	-	-	-	*M*	-	-	-	-
H	-	-	*H*	-	*H*	-	-	-	-	*M*	-	-	-	-
H	-	*H*	*H*	*H*	-	-	-	-	-	*H*	-	-	-	-
-	*H*	-	*H*	-	-	-	-	-	-	*H*	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		**12**	**12**	**12**	**12**	**12**
S-1	**SLO-1**	**Bonjour, ça va ?**	**Salut ! Je m'appelle Agnès**	**Qui est –ce ?**	**Dans mon sac, j'ai…**	**Il est comment ?**
	SLO-2	**Salut**	**Paul, Valérie, Manish**	**Les exemples**	**Da ns ton sac**	**Les objectifs**
S-2	**SLO-1**	Les pays	Les pronoms personnels sujets	Les professions	La formation du féminin (3)	L'aspect physique
	SLO-2	Les nationalités	Je, Tu, Il/Elle Nous, vous, Ils/Elles	Les exemples	Les féminins	Le corps
S-3	**SLO-1**	Les animaux domestiques	Les verbes être et avoir	Quelques objets	La phrase interrogative	Le caractère
	SLO-2	Les animaux	Les verbes auxiliaires	Objets	Les interrogatives	Les exemples
S-4	**SLO-1**	Les jours de la semaine	Les articles définis et indéfinis	La fiche d'identité	*qu'est – ce que.. ?*	Les prépositions de lieu (1)
	SLO-2	Les mois de l'année	Les exemples	La carte d'identité	*Les exemples*	Dans, sur, sous etc..,
S-5	**SLO-1**	Les nombres de 0 à 69	La formation du féminine (1)	La liaison	*Qu'est – ce que C'est*	Les nombre à partir de 70
	SLO-2	Les nombres	Les féminins	Les activités	*Les objets*	Les exemples
S-6	**SLO-1**	La famille (1)	La formation du pluriel (1)	L'élision	*Qui est – ce ?*	**Allo ?**
	SLO-2	Ses parents	Les exemples	Les activités	*Les personnes*	**Portable**
S-7	**SLO-1**	L'accent	Les adjectifs possessifs	Intonation descendre	*la phrase négative*	La formation du féminin(3)
	SLO-2	L'accent tonique	Les exemples	Les descendre	*La négation*	Les exemples
S-8	**SLO-1**	Les articles définis	Entrer en contact : salut	Intonation montante	*C'est*	Les articles contractés
	SLO-2	Les articles indéfinis	Entrer en contact : demander	Les montantes	*Il est*	Les articles partitifs
S-9	**SLO-1**	Bonjour, - Salut !	Dire comment ça va	Dans mon sac	*Les verbes du premier group*	Les pronoms personnels toniques
	SLO-2	Ca va	Comment allez-vous ?	Des objets	*Les exemples*	Les pronoms

S-10	**SLO-1**	Je m'appelle Agnès	Se présenter	Les Mots	Les verbes *aller*	Les adverbes interrogatifs
	SLO-2	Quel est votre nom	Présenter quelqu'un	Les expressions	Le verbe venir	Les interrogatifs
S-11	**SLO-1**	Les Mots	*Demander*	Demander poliment	Demander et répondre poliment	Les verbes du deuxième group
	SLO-2	Les Expressions	*Demander le temps*	Répondre poliment	Les exemples	Les exemples
S-12	**SLO-1**	Entrer en contact	Demander la date	Demander des informations personnelles	Demander des informations personnelles	Décrire l'aspect physique
	SLO-2	Se présenter.	Dire la date	Les exemples	Les activités	Décrire le caractère

Learning Resources	***Theory:*** 1. **''Génération-AI''** Méthode de français, Marie-Noëlle COCTON, P.DAUDA, L.GIACHINO, C.BARACCO, Les éditions Didier, Paris, 2018. 2. ***Cahier d'activités avec deux discs compacts.***

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	30%	30%	30%	30%	20%	20%	20%	20%	30%	-
	Understand										
Level 2	Apply	40%	40%	50%	50%	50%	50%	50%	50%	50%	-
	Analyze										
Level 3	Evaluate	30%	30%	20%	20%	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
	Dr. C.Thirumurugan Associate Professor, Department of French, Pondicherry University	*Kumaravel K. Assistant Professor & Head, SRMIST*
		Ponrajadurai M Assistant Professor, SRMIST

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Course Code	ULE20AE1T	Course Name	English	Course Category	*AE*	Ability Enhancement Course	L	T	P	C
							4	0	0	4

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Extend and expand the integrity in an individual which shall never allow him/her to compromise upon a noble way of living*
CLR-2 :	Enable the students to overcome the fear of speaking a foreign language and enable them to think through a foreign language.
CLR-3 :	Make them communicate an unbiassed way of thinking in a better manner
CLR-4 :	Develop strategies of comprehension of texts based on different culture and life styles
CLR-5 :	Strengthen spoken and written skills of the student in English
CLR-6 :	Help them express their sentiments, emotions and opinions, and reactions to information and situations in a civilized, cultured and humane manner.

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	*To acquire knowledge of becoming better beings through the tools of Language and Literature*	*2*	*75*	*60*	*H*	*H*	*H*	*-*	*-*	*H*	*-*	*H*	*-*	*H*	*H*	*H*	*-*	*-*	*-*
CLO-2 :	*To acquire a strong knowledge on concept, culture, civilization through English Literature*	*2*	*80*	*70*	*-*	*H*	*-*	*H*	*-*	*H*	*-*	*H*	*-*	*-*	*H*	*H*	*-*	*-*	*-*
CLO-3 :	*To develop own content and to be able to translate using the features in English Language*	*2*	*70*	*65*	*H*	*-*	*-*	*H*	*-*	*H*	*-*	*H*	*-*	*-*	*H*	*H*	*-*	*-*	*-*
CLO-4 :	*To interpret the contents in the texts presented in English Language*	*2*	*70*	*70*	*H*	*-*	*H*	*H*	*H*	*H*	*-*	*H*	*-*	*-*	*H*	*-*	*-*	*-*	*-*
CLO-5 :	*To present an improved and healthier communication and intercultural elements acquired through English Literature*	*2*	*80*	*70*	*-*	*H*	*-*	*H*	*-*	*H*	*-*	*H*	*-*	*-*	*H*	*-*	*-*	*-*	*-*
CLO-6 :	*To participate in any level of conversation and discussion presented in English with both proficiency in the language and positive caliber in the content of speech*	*2*	*75*	*70*	*H*	*H*	*-*	*H*	*M*	*H*	*M*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*

Duration (hour)		12	12	12	12	12
S-1	SLO-1	*Introduction to the art of poetry writing will be done*	*Post-colonial impacts in India as observed in their language and culture will be discussed.*	*Story through images is explained to the students*	*The definition and purpose of monologue is explained*	Homophones and Homonyms are to be explained in the class along with examples of usage.
	SLO-2	*The rationale behind this unit will be discussed.*	*The students will be encouraged to impart their views*	*The students are asked to create their own stories from those images*	*the sample monologues are to be provided to the learners*	How where and when these as vocabulary can be used is to be explained
S-2	SLO-1	*Feminism through Kamaladas' poem' In Kindergarten' is explained*	*Mathraboothan and the mother tongue influence in English – a discussion*	*Every day the students are made to bring their own cartoons to tell stories related to social issues and political issues.*	*The learners are made to create their own monologue contents.*	*Cross word puzzles are to be given to the students to make them understand the differences and usage of homophones and homonyms*
	SLO-2	*feminist critique's stand through poets like Meena Kandasamy is discussed*	*Students from different regions are asked to talk. The peculiarity in their pronunciation is to be identified by them*	*How to identify irony and sarcasm is taught*	*The contents are assessed and the lacuna is informed*	*The students are evaluated by making them use homophones and homonyms on their own*
S-3	SLO-1	*The writer Meena Kandasamy is invited to read her poems on women.*	*Enjoywithinlimits, says Mr Mathruboothamistaught and discussed*	*International Political memes to be created in the class*	*Discuss the contents created by the students and reiterate the idea that a monologue should mimic a story and has to have a proper beginning middle and an end.*	*How exactly to decide a proper word at a given situation is to be practically explained in the class.*
	SLO-2	*Questions on her perspectives are to be posed by the students*	*Everymistakefound in the textisanalysed*	*Memes on popular issues to be created in the class*	*The created monologues are to be assessed by the students themselves*	*Mundane situations are to be given to the students to check their ability to use those words*
S-4	SLO-1	*Gender inequality is discussed through A K Ramanujam and his poetry*	*The structure of sentence in English and the distorsion of the sentence isverified*	*Autobiography and biography differences are explained*	*To ask the students to bringnewspaper to class and makethem select a column and readitloudly.*	*To give all the parts of speech not according to the grammar book order but according to a method which would easily make one understand correlation of one with the other. For instance – Noun, Pronoun, Adjective, Verb, Adverb… will have to be the order*
	SLO-2	*Different legal situations where both the genders suffer is explained in the class*	*Diffèrent sentences are given and tested*	*Certain Classic autobiographies and biographies are presented*	*No meaningis to beexplained. Just the flow is to bechecked.*	*The students are made to use as many adjectives as possible for describing their friends*
S-5	SLO-1	*Kalki the poetisinvited to conduct a guets lecture on herownpoem.*	*Nobel? What Nobel, asks MrMathrubootham is discussed*	*How to give voice to an inanimate object.*	*Another reading loud session of the same passages are to be conducted along with dictionary checking for meanings are to be done.*	*The parts of speech must beused in different sentences*
	SLO-2	*Questions on her perspectives are to be posed by the students*	*The attitudes of people in a ludicrous manner is discussed*	*Different objects are given to the students and they are asked to give autobiographical notes to them*	*The new meanings that the students get must be compared with the given word and the distance between the meanings are to be explained*	*theteacherought to use the board to draw a situation to make one understandeachpart's usage.*
S-6	SLO-1	*Seminar to generate discussion to enhance gender sensitivity is conducted*	*The Text is analyzed in detail*	*Practically test the students in class by giving them different concrete objects.*	*To make them compare and realize how they had overcome their fear for English*	*Along with parts of speech particularly when Verb is being taught Tenses ought to be taught with same methodology mentioned above.*
	SLO-2	*Case studies are to be incorporated by the students in their seminar*	*More insights into Indian English is given*	*Ask the students to evaluate each other's autobiography on concrete objects*	*The comprehensive techniques are taught*	*The students are asked to create a lighter vein situation and asked to use all the tenses*
S-7	SLO-1	Human interest columns in news papers - tragedies on women men and transgender documented is read aloud and discussed in the class room.	*Neutral accent is taught along with right pronunciation*	*Caption writing is taught*	*To develop the ability to pick up a conversation istaugh*	*The rules of Tenses are taught with live examples in the classes.*
	SLO-2	. how much are the students able to relate with or able to feel emotionally for those situations is to be checked and analysed	*Test is to be conducted to check how far a student is able to understand neutral accent*	*The purpose of the caption writing is to be instilled*	*to engage in conversations and be able to interupt and end conversation appropriatelywillbetaught*	*Ability to use all the rules in tenses is taught.*
S-8	SLO-1	*Case studies to be given to the students to document their reactions*	*Mr Mathruboothamisfullysupporting all new technologies – discussion*	*Different examples for captions are given*	*Different situations to be given to the students to engage in a conversation.*	*The basic way to pick an error is by already knowing the rules of grammar thoroughly.*
	SLO-2	*Find out if there is any student finding it hard to emote or is insensitive toward the moment*	*Humor and sarcasmisskimmedfrom the text*	*The studenst are asked to create captions similar to the ones shown in the class*	*The students are asked to find errors in each others' monologue*	*Hence all the rules are to be brushed up*

S-9	**SLO-1**	*Students are to made to createtheirownenactable content on the prevailinggenderinequalities*	*How to write a statement and question is to be taught with reference to the text.*	*The students are made to give captions different news articles, products and situations*	*To test how much one is able to use ironyhumor and sarcasm in one's conversation*	*Excercises on all sorts of possible errors are given to the students and asked to rectify.*
	SLO-2	*The students are asked to improvise on dialogue on theirown*	*The way sentences are constructed according to the regional impact is discussed*	*The best is appreciated for its qualities of being best*	*Natural usage of punisexplained*	*Mathrabootham's passages are given to the studentsagain to check the errors.*
S-10	**SLO-1**	*Feminism vs Gender inequality a test for the students to chart out the existing gulf*	*Pizza maavu : Welcome to Mr Mathruboothamfoodrecipiewebsiteisdiscussed*	*Public Speakingexamplessince Julius Caesar to Martin Luther isgiven*	*To teachdifferentkinds of reading. -skimming scanning and intensive reading extensive reading is taught*	*Definesynonym and antonym. Ask the sudents to identifysynonyms and antonyms in text.*
	SLO-2	*False allegations and Legal situations sometimes created by women to corner men only degrades the freedom struggle of women – discuss*	*The students are made to explain the textthemselves*	*The techniques used by different leaders sinceagesisdiscussed*	*Teh students are practicallyasked to use thosemethodology to understand a text*	*Demonstartetheriunderstanding of synonyms and antonyms in active learning. Introduce thesaurus reference.*
S-11	**SLO-1**	*A detailed discussion on the 4 poets is done in the class through comparative method*	*Identify the errors and make students to rewrite first two texts*	*The Ted X talks are played in the class, different political leader's canvasing is presented*	*The students are made to read the passages loudly*	*Demeonstrateunderstanding of words by relatingthem to their opposites (antonyms)*
	SLO-2	*While comparison the students are able to get a deeper analytical way of thinking and are able to present an all encompassed points*	*Check if they are able to retain the humor in the text after correcting the sentences*	*What makes a talk impressive is identified and discussed*	*The students are asked questions from the passages to check their retention capacity*	*Demonstrateunderstandingof wordswithsimilar but not identicalmeanings (synonyms)*
S-12	**SLO-1**	*The comprehension and retention and application of all the acquired knowledge of the student is checked by initiating an informal discussion in the class.*	*Identify the errors and make the students to rewrite the last two texts*	*The students are givendifferent topics to give impromptu*	*The learner is made to select phrases and words from the given passages and is asked to use it in own sentences*	*With the studentsbrainstormshortlist of commonlyusedwords*
	SLO-2	*The overall development in the student's EQ pertaining to gender oriented issues will be sensible and objective.*	*Check if they are able to retain the humor in the text after correcting the sentences. Explain the result to them*	*The best talk isrecorded and made available for other'srefferences*	*The ability to converse with humor sarcasm or deep thoughts and with the capacity to emote the desired emotion in the other is checked*	*Askthem to rapidlygivesynonyms and antonyms to thosewords*

Learning Resources	***Theory:*** 1. Horizon- English Text Book – Compiled and Edited by the Faculty of English Department, FSH, SRMIST, 2020 2. *English Gramar in Use by Raymond Murphy*

Learning Assessment

	Bloom's Level of Thinking	**Continuous Learning Assessment (50% weightage)**								**Final Examination (50% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (20%)**		**CLA – 4 (10%)#**			
		Theory	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**
Level 1	Remember	30%	-	30%	-	30%	-	30%	-	30%	-
	Understand										
Level 2	Apply	30%	-	30%	-	30%	-	30%	-	30%	-
	Analyze										
Level 3	Evaluate	40%	-	40%	-	40%	-	40%	-	40%	-
	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. Daniel David, Prof & Head, Department of English, MCC, Chennai	*Dr. Shanthichitra, Associate Professor, & Head, Department of English, FSH,SRMIST*
		Dr K B Geetha, Assistant Professor, Department of English, FSH, SRMIST

ENGLISH (ULE20AE1T)

FACULTY OF SCIENCE AND HUMANITIES

SRMIST

SYLLABUS

The overall aims of the course are to enable the learner to think and communicate effectively and appropriately in real life situation and to use English effectively for study purpose across the curriculum and most importantly to develop interest in and appreciation of Literature and thereby get an understanding of world and the society one live.

The Objective of this course is to reveal all aspects of human conditions through literature and to develop an individual who learns to communicate in English language in any situation. The capacity to listen to think to speak to read and to write will be built in a student.

Credit : 04

UNIT I

POETRY

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

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

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

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

UNIT IV
LISTENING AND READING
1. MONOLOGUES
2. CONVERSATIONS
3. LOUD READING
4. READING COMPREHENSION

UNIT V
LANGUAGE COMPONENTS
1. STORY THROUGH IMAGES
2. AUTOBIOGRAPHY OF CONCRETE OBJECTS
3. PARTS OF SPEECH
4. TENSES
5. ERRORS IN SENTENCES

Reference Books : English Grammar in Use by Raymond Murphy

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Course Code	UPY20101J	Course Name	Properties of Matter and Acoustics	Course Category	C	Core Course	L	T	P	C
							4	0	4	6

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	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 different kinds of moduli via experimental methods*			
CLR-2:	*Familiarize the concept of bending in beams*			
CLR-3:	*Understand the surface tension, boundary property and viscosity*			
CLR-4:	*Understand the wave phenomena: in general, and sound wave in particular*			
CLR-5:	*Acquire knowledge on the production of ultrasonic waves*			
CLR-6:	*Gain the fundamental Understanding on various aspects of building acoustics*			

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 concept of bending and twisting*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-2:	*Explore how temperature affects surface tension and viscosity*	2	80	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-3:	*Know about the concept of Doppler effect and implications*	2	75	70	H	H	H	H	H	H	H	H	M	H	M	H	H	H	H
CLO-4:	*Understand the generation of ultrasonic waves*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-5:	*Determine various physical quantity like, elasticity, viscosity, surface tension and frequency through experiments*	2	80	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-6:	*Solve problems to determine various physical quantity like, elasticity, viscosity, surface tension and frequency*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H

Duration (hour)		24	24	24	24	24
S-1	SLO-1	Elasticity – Three types of elastic moduli	Rate of Flow of a liquid	Surface Tension	Sound Waves	Classification of Sound waves
	SLO-2	Relation among elastic moduli	Lines and Tubes of Flow	Molecular Forces and its types	Speed of Sound Waves	Ultrasonics
S-2	SLO-1	Poisson's ratio	Energy of the Liquid - Kinetic energy and Potential Energy	Explanation of Surface Tension on kinetic energy	Intensity Level	Properties of Ultrasonics
	SLO-2	Problem solving on determination of Poisson's ratio	Problem solving on rate of flow of liquid	Problem solving on determination of molecular forces	Problem solving on determination of speed of sound waves	Concept of Magnetostriction Effect
S-3	SLO-1	Bending of beams	Pressure energy of the liquid	Surface energy and Surface tension	Interference of sound waves	Concept of Piezo Electric Effect
	SLO-2	Expression for bending moment	Viscosity	Free Energy of a Surface and Surface Tension	Doppler Effect	Production of Ultrasonics using Magnetostriction Oscillator

S-4	SLO-1	Depression of the loaded end of a Cantilever	Coefficient of Viscosity	Pressure difference across a liquid surface	Applications of Doppler Effect	Production of Ultrasonics using Piezoelectric Oscillator
	SLO-2	Numerical on determination of Depression	Problem solving on determination of Coefficient of Viscosity	Numerical on determination of Surface Tension	Problem solving on determination of frequency shift	Problem solving on determination of frequency of ultrasonic
S-5 to S-8	SLO-1	Basics of Experimentation	Determination of Young's modulus of the material of the beam – Non-Uniform 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-9	SLO-1	Uniform Bending method: Theory	Critical Velocity	Angle of contact	Concept of Free Vibrations	Applications of Ultrasonics – NDT, SONAR
	SLO-2	Uniform Bending method: Experiment pin and microscope method	Poiseuille's Equation for flow of liquid through a tube and its correction	Determination of Angle of Contact	Concept of Damped Vibrations	Applications of ultrasonic in medicine
S-10	SLO-1	Work done in uniform bending	Capillary flow method - Experimental Determination of Coefficient of Viscosity for a liquid	Excess of pressure inside curved surface	Theory of Forced Vibrations	Acoustics: Intensity Level, Loudness
	SLO-2	Numerical on Bending of Beams	Problem solving on determination of Viscosity of a liquid	Numerical on determination of angle of contact	Numerical on forced vibrations	Acoustics of buildings
S-11	SLO-1	Non-Uniform Bending method: Theory	Comparison of Viscosities -Ostwald Viscometer	Formation of drops	Resonance	Reverberation
	SLO-2	Non-Uniform Bending method: Experiment pin and microscope method	Bernoulli's Theorem	Experimental study of variation of Surface tension with temperature	Sharpness of Resonance	Reverberation time
S-12	SLO-1	Numerical on Uniform Bending Method	Applications of Bernoulli's Theorem-The Atomizer	Drop weight method of determining surface tension	Fourier's theorem	Derivation of Sabine's formula
	SLO-2	Numerical on determination of depression	Problem solving on determination of pressure of liquid	Numerical on determination of Excess Pressure inside curved surface	Numerical on Fourier theorem	Numerical on determination of reverberation time
S-13 to S-16	SLO-1	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
	SLO-2					
S-17	SLO-1	Koenig's method for non-uniform bending	Motion in viscous medium	Angle of contact of mercury	Application of Fourier's theorem – Saw Tooth wave	Determination of absorption coefficient
	SLO-2	Koenig's method: theory	Stokes method for the Coefficient of a highly viscous liquid	Quincke's method	Numerical on Fourier theorem	Optimum Reverberation time
S-18	SLO-1	Rigidity Modulus: Theory - Expression for couple per unit twist	Variations of viscosity with temperature and pressure	Surface tension and Vapor pressure osmosis	Application of Fourier's theorem – Square wave	Factors affecting Acoustics of buildings
	SLO-2	Numerical on determination of Young's modulus	Problem solving on determination of Coefficient of Viscosity using stokes method	Numerical on determination of Surface Tension	Numerical on Fourier theorem	Numerical on determination of absorption coefficient
S-19	SLO-1	Torsion pendulum	Determination of Viscosity of Gases	Experimental determination of osmotic pressure	Frequency Determination and Sonometer	Source of Noise
	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	A.C. frequency using sonometer-Theory	Impact of Noise
S-20	SLO-1	Static torsion method with scale and telescope	Rankine's method for the determination of viscosity of a gas	Osmotic and vapor pressure of a solution	Determination of frequency using Melde's apparatus	Control of Noise
	SLO-2	Numerical on determination of Rigidity Modulus	Numerical on determination of viscosity of gas	Numerical on determination of Osmotic Pressure	Numerical on determination of frequency	Sound level meter
S-21 to S-24	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
	SLO-2					

Learning Resources	1. Properties of Matter, Revised Edition, DS Mathur (S. Chand and Company2008). 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, 2005).	4. University Physics, Ronald Lane Reese, (Thomson Brooks/Cole, 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 (Narosa, 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 %	30 %	30 %	30 %	30 %	30 %
	Understand										
Level 2	Apply	40 %	40 %	40 %	40 %	40 %	40 %	40 %	40 %	40 %	40 %
	Analyze										
Level 3	Evaluate	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

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

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Course Code	UPY20102T	Course Name	Classical Mechanics and Relativity	Course Category	C	Core Course	L	T	P	C
							4	2	0	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:
CLR-1:	*Emphasize the mathematical formulation of mechanics problems*
CLR-2:	*Understand, explain and derive the various mechanics problems*
CLR-3:	*Apply the fundamental concepts of classical mechanics to the simple force field and system of particles*
CLR-4:	*Lay the solid background of mathematical methods to employ in modern physics*
CLR-5:	*Develop problem solving and critical thinking skills*
CLR-6:	*Develop basic understanding of relativity*

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:	*General concepts of velocity, momentum and energy are studied.*	2	80	75
CLO-2:	*Learn the Reference frames – equations of motion in simple force fields*	2	80	70
CLO-3:	*Basic knowledge about Rotating frame and Kepler's laws*	2	75	70
CLO-4:	*Know about the system of particles-Conservation laws, Kinetic energy*	2	80	75
CLO-5:	*Learn about the constraint forces, D'Alembert's principle and Lagrangian*	2	80	70
CLO-6:	*Learn the basic aspects of relativity*	2	80	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	PSO - 1	PSO - 2	PSO - 3
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	M	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H

Duration (hour)		18	18	18	18	18
S-1	SLO-1	Algebra of Vectors	Reference frames	Motion of particle in two and three dimensions	System of particles	Fundamental Frame of reference and Accelerated frame of reference
	SLO-2	Adding and Subtracting Vectors	Inertial frame	Non-Inertial frame and Pseudo Force	Linear Momentum of system of particles	Newtonian Relativity
S-2	SLO-1	Scalar Product (Dot Product), The Law of Cosines	Newton's I Law of Motion	Rotating frame of reference	Conservation of linear momentum of system of particles	Galilean Transformations
	SLO-2	Work and the Dot Product	Newton's II and III Law of Motion	Derivation of expression for fictitious force	Angular momentum for system of particles	Concept of space, mass and time
S-3	SLO-1	Vector Product (Cross Product)	Galilean Transformation	Concept of Centrifugal force	Conservation of angular momentum for system of particles	Michelson-Morley Experiment
	SLO-2	Examples of the Vector Product in Physics	Transformation Equations	Concept of Coriolis force	Kinetic energy of system of particles	Ether Hypothesis: Explanation of negative result
S-4	SLO-1	Components of a Vector	Galilean invariance	Central Force-1	Constraints	Postulates of special theory of relativity
	SLO-2	Constructing a Vector Perpendicular to a Given Vector	Motion under constant force	Central Force-2	Classification of constraints	Explanation of the postulates
S-5	SLO-1	Problem solving: The Position Vector r and Displacement	Problem solving: Motion of a particle in one dimension	Problem solving: Rotating frame of reference	Problem solving: Conservation of angular momentum	Problem solving: Newtonian relativity
	SLO-2	Problem solving: Velocity and Acceleration Motion in One Dimension	Problem solving: Time dependent force	Problem solving: Central Force	Problem solving: Kinetic energy	Problem solving: Galilean Transformations
S-6	SLO-1	Problem solving: Ideas of velocity and acceleration to several dimensions using vector notation.	Problem solving: Velocity dependent damping force	Problem solving: Characteristics of motion under central force	Problem solving: constraints	Problem solving: Michelson-Morley Experiment
	SLO-2	Problem solving: Ideas of velocity and acceleration to several dimensions using vector notation	Problem solving: Velocity dependent damping force	Problem solving: Characteristics of motion under central force	Problem solving: constraints	Problem solving: Ether drag
S-7	SLO-1	Finding Velocity from Acceleration	Linear momentum for a particle	General Equation to any central orbit	Work done by constraint forces	Concept of Lorentz Transformation Equations
	SLO-2	Finding Velocity from Acceleration	Conservative force	Energy in a central force field	Virtual displacement and Virtual work	Derivation of Lorentz Transformation Equations
S-8	SLO-1	Motion in a Uniform Gravitational Field	Conservation of linear momentum for a particle	Kepler's laws of planetary motion	Principle of virtual work	Consequences of the relativity
	SLO-2	Motion in a Uniform Gravitational Field	Concept of potential	Law of gravitation from Kepler's laws		Length Contraction, Time Dilation
S-9	SLO-1	Rotating Vectors	Non- conservative force	Derivation of Kepler's laws	D'Alembert's principle	Simultaneity and relativity of time
	SLO-2	Circular Motion and Rotating Vectors	Force as gradient of potential energy	Derivation of Kepler's laws	D'Alembert's principle	Twin Paradox
S-10	SLO-1	Polar Coordinates, dr/dt and dθ/dt in Polar Coordinates	Solution of the equations of motion in simple force fields in one dimensions using Cartesian, cylindrical polar coordinate systems.	Concept of Artificial Satellites	Problem solving	Doppler Effect

	SLO-2	Velocity in Polar Coordinates	Solution of the equations of motion in simple force fields in one dimensions using spherical polar coordinate systems.	Artificial Satellites – Derivation of Time Period	Problem solving	Why the universe is believed to be expanding?
S-11	**SLO-1**	Problem solving: Velocity from Acceleration	Problem solving: Solution of the equations of motion in simple force fields in two dimensions using Cartesian, cylindrical polar coordinate systems.	Problem solving: central force field	Problem solving: Applications of D'Alembert's principle: Atwood's machine	Problem solving: Lorentz Transformations
	SLO-2	Problem solving: Velocity in Polar Coordinates	Problem solving: Solution of the equations of motion in simple force fields in two dimensions using spherical polar coordinate systems.	Problem solving: Kepler's laws	Problem solving: Applications of D'Alembert's principle: Atwood's machine	Problem solving: Length Contraction
S-12	**SLO-1**	Problem solving: Polar Coordinates: Velocity of a Bead on a Spoke (wheel)	Problem solving: Solution of the equations of motion in simple force fields in three dimensions using Cartesian, cylindrical polar coordinate systems.	Problem solving: Geostationary Satellite	Problem solving: Applications of D'Alembert's principle: Two-body central force problem	Problem solving: Time Dilation
	SLO-2	Problem solving: Polar Coordinates: Velocity of a Bead on a Spoke (wheel)	Problem solving: Solution of the equations of motion in simple force fields in three dimensions using spherical polar coordinate systems.	Problem solving: Eccentricity of the orbit of a satellite	Problem solving: Applications of D'Alembert's principle: Simple Pendulum	Problem solving: Twin Paradox
S-13	**SLO-1**	Polar Coordinates: Find velocity of a particle moves with constant speed v around a circle	Simple harmonic oscillator-1	Escape Velocity	Degrees of freedom	Addition of velocities
	SLO-2	Acceleration in Polar coordinates	Simple harmonic oscillator-2	Expression for escape velocity	Examples of Degrees of freedom	Concept of variation of mass with velocity
S-14	**SLO-1**	Kinetic Energy	Conservation of energy for a particle-1	Center of mass	Generalized coordinates-Transformation Equations	Derivation of variation of mass with velocity
	SLO-2	Conservative force fields	Conservation of energy for a particle	Derivation-linear distribution of mass	Characteristics of Generalized coordinates	Mass Energy Equivalence
S-15	**SLO-1**	Potential Energy or Potential	Centre of Mass-2	Rigid Body	Lagrangian	Concept of rest mass Equivalence
	SLO-2	Potential Energy or Potential	Description of the concept of Centre of Mass	Concept of translation and rotation	Lagrange's Equations	Mass Energy
S-16	**SLO-1**	Torque and Angular Momentum	Motion of falling bodies in a variable Gravitational field-1	Relation between linear and angular kinematics	Derivation of Lagrange's equation of motion for a conservative system	Relationship between total energy, rest energy and momentum
	SLO-2	Conservation of angular momentum	Motion of falling bodies in a variable Gravitational field-2	Relation between linear and angular kinematics	Derivation of Lagrange's equation of motion for a conservative system	General Relativity and Gravitation: Future Prospects
S-17	**SLO-1**	Problem solving: Potential Energy or Potential	Motion of a projectile in Uniform gravitational field-1	Problem solving: Center of mass	Problem solving: Lagrangian for a free particle	Problem solving: Addition of velocities
	SLO-2	Problem solving: Potential Energy or Potential	Motion of a projectile in Uniform gravitational field-2	Problem solving: Rigid Body	Problem solving: Lagrangian	Problem solving: Mass energy equivalence
S-18	**SLO-1**	Problem solving: Kinetic Energy	Problem solving: Motion of falling bodies	Problem solving: Rotation about a fixed axis	Problem solving: Hamiltonian	Problem solving: Energy Momentum
	SLO-2	Problem solving: Conservation of angular momentum	Problem solving: Motion of falling bodies	Problem solving: Rotation about a fixed axis	Problem solving: Hamiltonian	Problem solving: Mass variation

Learning Resources	1. Fundamentals of Physics, Halliday, David; Resnick, Robert; Walker, Jearl (Wiley, 2010) 2. Mechanics Berkeley Physics course, v.1 Charles Kittel (Tata McGraw Hill, 2007) 3. Mechanics, DS Mathur, (New edition edition,S Chand, 2000)	4. Solved Problems in classical Mechanics, O.L. Delange and J. Pierrus (Oxford Press, 2010) 5. Classical Mechanics (3rd Edition), Herbert Goldstein (Pearson, 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 %	-
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
Dr. DK Aswal, NPL, dkaswal@nplindia.org	Prof. V Subramanian, IIT Madras, manianvs@iitm.ac.in	Dr. M. Krishna Mohan, 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	UMA20A01T	Course Name	Allied Mathematics-I	Course Category	G	Generic Elective Course	L	T	P	C
							3	0	0	3

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Understand the concept of sets, relations and functions
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
CLR-6 :	Understand various Mathematical evaluation procedure

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 Engineering Knowledge	PLO 2 Problem Analysis	PLO 3 Design & Development	PLO 4 Analysis, Design, Research	PLO 5 Modern Tool Usage	PLO 6 Society & Culture	PLO 7 Environment & Sustainability	PLO 8 Ethics	PLO 9 Individual & Team Work	PLO 10 Communication	PLO 11 Project Mgt. & Finance	PLO 12 Life Long Learning	PSO 1	PSO 2	PSO 3
CLO-1 :	Acquire the knowledge on sets and functions	3	80	85	M	H	-	-		-	-	-	-	-	-	H	-	-	-
CLO-2 :	Gain the ability to identify science and engineering problems logically	1	75	80	M	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Understand the basic ideas about polynomial equations	3	85	80	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Appreciate the concepts of Matrices in real life situations	3	80	75	M	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Apply the knowledge of different calculus techniques	1	75	85	M	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	obtain the knowledge on Mathematical evaluation method	3	80	85	M	-	-	-	-	-	-	-	-	-	-	H	-	-	-

Duration (Hour)		9	9	9	9	9
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	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-5	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-6	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-7	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-8	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-9	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

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

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%) #			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30 %	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40 %	-
	Analyze										
Level 3	Evaluate	20 %	-	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	UPY20S01T	Course Name	Digital Signal Processing	Course Category	S	Skill Enhancement Course	L	T	P	C
							0	2	0	2

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*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:	*Study the parameters of a signal and generation of a signal with specific parameters*			
CLR-2:	*Estimate Signal to Noise Ratio (SNR) of a signal*			
CLR-3:	*Estimate fundamental frequency component in a given signal using Fourier transform*			
CLR-4:	*Estimate Mean Square Error (MSE) between two signals*			
CLR-5:	*Study various filtering techniques*			
CLR-6:	*Design Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) filters*			

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 about the parameters of a signal and generation of sequences*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-2:	*Understand the necessity of estimation of SNR and MSE*	2	80	70	H	M	M	H	M	H	H	H	M	H	M	H	M	H	M
CLO-3:	*Understand how Fourier transforms help in estimating frequency content of a signal*	2	75	70	H	M	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-4:	*Understanding different types of Fourier Transformations*	2	80	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-5:	*Understanding convolution and cross correlation of two signals*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-6:	*Gain knowledge on designing digital filters in MATLAB.*	2	80	75	M	H	H	M	H	H	H	H	H	H	M	H	H	H	H

DURATION (HOURS)		6	6	6	6	6
S1 to S2	SLO-1	MATLAB basics: commands, functions, variables, plotting etc.	Write a MATLAB code to create a signal equal to the sum of two sine waves with the following characteristics: a) 3–second duration b) Sampling frequency = 2 kHz c) Sinusoid 1: frequency 50 Hz (low), amplitude 10, phase = 0 d) d)Sinusoid 2: frequency 950 Hz (high), amplitude 1, phase =0	Write a MATLAB code to estimate Mean Square Error (MSE) between a clean signal (signal free from noise) and a noisy signal.	Write a MATLAB code to perform convolution and cross correlation between two signals.	Design a digital IIR lowpass filter using MATLAB/Simulink with the following specifications: a) Filter Order: 8th Filter type: elliptic IIR b) Passband cutoff frequency: fp= 300 Hz c) Passband Ripple: Rp= 0.5 dB d) Stopband attenuation: Rs= 50 dB Sampling frequency: fs= 4 kHz
	SLO-2					
S3 to S4	SLO-1	Generation of Unit Sample Sequence, Unit Step, Ramp Function, Discrete Time Sequence, Real Sinusoidal Sequence	Write a MATLAB code to create a sawtooth wave with a frequency of 50 Hz of 100 samples and a random noise signal of 100 samples. Compute the powers of both the signals in terms of dB.	Study of Fourier Transform, Discrete Fourier Transform and Fast Fourier Transform.	Design of a Butterworth Analog Filter for Low Pass and High Pass.	Design a digital FIR bandpass filter using MATLAB/Simulink with the following specifications: a) Passband: 8–12 kHz b) Stopband Ripple: Rs= 0.001 c) Passband Ripple: Rp= 0.001

	SLO-2					d) Transition width: 3 kHz Sampling frequency: fs= 44.1 kHz
S5 to S6	**SLO-1**	Generate and Plot Sequences over an interval	Write a MATLAB code to estimate the Signal to Noise ratio (SNR) of a signal in terms of dB (Generate sinusoidal and noise signals of known powers for estimation of SNR).	Write a MATLAB code to create a signal composed of two different frequencies and implement low pass and high pass filtering. Evaluate the output with fft function.	Design a digital FIR lowpass filter using MATLAB/Simulink with the following specifications: a) Passband cutoff frequency: fp=2 kHz b) Stopband cutoff frequency: fs=3 kHz c) Passband Ripple: Rp=0.25 dB d) Stopband attenuation: Rs= 0.25 dB Sampling frequency: fs=20 kHz	Design a digital IIR bandpass filter with Butterworth characteristics using MATLAB/Simulink meeting the following specifications: a) Passband: 8–10 kHz b) Sampling frequency: fs= 44.1 kHz c) Filter Order: 4 d) Filter Characteristics: Butterworth Obtain the filter coefficients and frequency response for the above FIR using the Blackman window method.
	SLO-2					

Learning Resources	1. Discrete Time Signal Processing, Oppenheim and Schafer (Pearson) 2. Digital Signal Processing: Principles, Algorithms and Applications, Proakis and Manolakis (Pearson) 3. Introduction to Digital Signal Processing using MATLAB 2nd Edition, Robert A. Schilling, Sandra L. Harris (Cengage Learning) 4. Digital Signal Processing with MATLAB Programs 6/e, Sharma S (S K KATARIA & SONS)	5. Essentials of Digital Signal Processing Using MATLAB, Vinay K. Ingle, John G. Proakis (Cengage Learning) 6. Digital Signal Processing Using MATLAB and Wavelets, Michael Weeks (Infinity Science Press) 7. Digital Signal Processing, Salivahanan (Tata McGraw Hill) 8. Digital Signal Processing, NagoorKani (Tata McGraw Hill) 9. Digital Signal Processing, Chen (Oxford)

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
Dr. DK Aswal, NPL, *dkaswal@nplindia.org*	Dr. Ranjit Kumar Nanda, IIT Madras, nandab@iitm.ac.in	Dr. A. Naga Rajesh, SRMIST
Dr. V Subramanian, CLRI, subbu@clri.res.in	Prof. C Vijayan, IIT Madras, cvijayan@iitm.ac.in	Dr. A Geetha, SRMIST

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Course Code	UPY20S02T	Course Name	Atmospheric Observations	Course Category	S	Skill Enhancement Course	L	T	P	C
							0	2	0	2

Pre-requisite Courses	***Nil***	**Co-requisite Courses**	***Nil***	**Progressive Courses**	***Nil***
Course Offering Department	***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:	*Familiarize with atmospheric instruments*			
CLR-2:	*Gain knowledge in atmospheric data analysis*			
CLR-3:	*Know the method of obtaining meteorological data from satellites*			
CLR-4:	*Interpret weather charts*			
CLR-5	*Enable the students to analyze satellite data*			
CLR-6	*Facilitate the comparison of Satellite – instrument data*			

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:	*Generate the interest on atmospheric instrumentation*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-2:	*Provide basic analytical techniques for atmospheric measurements*	2	80	70	H	M	M	H	M	H	H	H	M	H	M	H	M	H	M
CLO-3:	*Enhance the basic knowledge of meteorological information from satellites*	2	75	70	H	M	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-4:	*Prepare the students with necessary atmospheric background*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-5	*Improving analytical skills of satellite data*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-6	*Enhancing the skills on in-situ measurements*	2	80	75	M	H	H	M	H	H	H	H	H	H	M	H	H	H	H

DURATION (HOURS)		6	6	6	6	6
S1 to S2	SLO-1	Point measurements of rainfall – Rain gauge	Calculation of integrated water vapor, actual and saturated vapor pressure using radiosonde data	Estimation of solar radiation and sun shine hours –comparison with Automatic Weather Station measurements	Handling reanalysis data to derive cloud liquid water content	Analysis of surface and upper air data for western disturbances
	SLO-2					
S3 to S4	SLO-1	Pressure –altitude relationships	Estimation of evapotranspiration from temperature-based methods	Wind measurements and plotting from Automatic Weather Station	Air quality index using PM10 measurement	Climate approach – Thornthwaite and Koppen
	SLO-2					
S5 to S6	SLO-1	Use of hypsometric equation from pressure – humidity relations	Estimation of evapotranspiration from micro–meteorology methods	Handling the INSAT data to understand the cloud cover and estimation of rainfall	Plotting of surface and upper air data and preparation of weather chart	Analysis on daily weather report
	SLO-2					

Learning Resources	
1.	Guide to Meteorological Instruments and Methods of Observation, WMO, (7th edition,2007).
2.	Meteorology Manual: The practical guide to the weather, Storm Dunlop, (Haynes Publishing, 2014)
3.	Atmospheric Science an Introductory Survey, John M Wallace and Peter V Hobbs, (Academic Press, International Geophysics Series, 2005)
4.	Handbook of Weather, Climate and Water, Thomas D Potter and Bradley R Colman, (Wiley Interscience, 2003).

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
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Course Code	UCD20S01L	Course Name	Soft Skills	Course Category	S	*Skill Enhancement Course*	L	T	P	C
							0	0	2	1

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Expose students to right attitudinal and behavioral aspects and to build the same through activities*
CLR-2 :	*Develop and nurture interpersonal skills of the students through individual and group activities.*
CLR-3 :	*Increase efficiency and leadership skills and to improve team results.*
CLR-4 :	*Acquire time management skills and develop creative skills*
CLR-5 :	*Understand intercultural communication and etiquettes required in a professional environment*
CLR-6 :	*Instill confidence in students and develop skills necessary to face the challenges of competitive exams and placements*

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 :	*Re-engineer their attitude and understand its influence on behavior*	*3*	*80*	*70*	*M*	*M*	*M*	*-*	*M*	*H*	*M*	*-*	*-*	*H*	*H*	*H*	*M*	*H*	*H*
CLO-2 :	*Acquire inter personal skills and be an effective goal oriented team player*	*3*	*80*	*70*	*M*	*M*	*M*	*-*	*M*	*H*	*M*	*-*	*-*	*H*	*H*	*H*	*M*	*H*	*H*
CLO-3 :	*Understand the importance of time management and creativity*	*3*	*85*	*75*	*M*	*M*	*M*	*-*	*M*	*H*	*M*	*-*	*-*	*H*	*H*	*H*	*M*	*H*	*H*
CLO-4 :	*Build confidence during any presentation*	*3*	*85*	*75*	*M*	*M*	*M*	*-*	*M*	*H*	*M*	*-*	*-*	*H*	*H*	*H*	*M*	*H*	*H*
CLO-5 :	*Develop interpretation skills and intercultural communication*	*3*	*85*	*75*	*M*	*M*	*M*	*-*	*M*	*H*	*M*	*-*	*-*	*H*	*H*	*H*	*M*	*H*	*H*
CLO-6 :	*Help the students succeed in competitive exams and placements*	*3*	*80*	*70*	*M*	*M*	*M*	*-*	*M*	*H*	*M*	*-*	*-*	*H*	*H*	*H*	*M*	*H*	*H*

Duration (hour)		6	6	6	6	6
S-1	SLO-1	*IKIGAI*	*Interpersonal Skills*	*Creating brands – activity (posters, flyers, business cards)*	*Value of Time*	*Intercultural communication – beliefs, customs and attitude of people in different countries (US,*

						UK, Japan, West Asia, China, Russia)
	SLO-2	*IKIGAI*	*Emotional Intelligence*	*Creating brands – activity (posters, flyers, business cards)*	*Diagnosing Time Management*	*Social and cultural etiquettes*
S-2	**SLO-1**	*Attitude*	*Importance of Team Work*	*Causes of Stress and Its Impact*	*Weekly Planner, To do list, Prioritizing work*	*Communication etiquettes*
	SLO-2	*Factors influencing Attitude*	*Team Building Activity*	*How to Manage Stress and Distress?*	*Time management activity*	*Telephone etiquettes*
S-3	**SLO-1**	*SWOT Analysis*	*Leadership skills*	*Understanding the Circle of Control*	*Creativity – think out of the box*	*Dinning etiquettes*
	SLO-2	*Individual SWOT Analysis - activity*	*Leadership skills based Activity*	*Stress Busters*	*Creativity Activity*	*Grooming etiquettes*
S-4	**SLO-1**	*Extempore Practice Session*	*Networking skills*	*Conflicts in Human Relations – reasons*	*Creativity Assessment Activity*	*Ice breaking*
	SLO-2	*Extempore Practice Session*	*Networking skills based Activity*	*Approaches to conflict resolution*	*Creativity Assessment Activity*	*Designing ice breaker games*
S-5	**SLO-1**	*Extempore Practice Session*	*Negotiation skills*	*Conflict resolution – case studies*	*Brainstorming, use of groups and individual brainstorming techniques to promote idea generation*	*Ice breaker activity*
	SLO-2	*Extempore Practice Session*	*Negotiation skills based Activity*	*Conflict resolution – case studies*	*Brainstorming session activities*	*Ice breaker activity*
S-6	**SLO-1**	*Extempore Practice Session*	*Entrepreneurial Skills*	*Importance and necessity of Decision Making*	*Brainstorming session*	*Introduction to resume building*
	SLO-2	*Extempore Practice Session*	*Entrepreneurial knowledge, Focus, Investment, Risk tolerance, Resilience, Negotiation, Ethics, Networking*	*Process of Decision Making, Practical Way of Decision Making, Weighing Positives and Negatives*	*Brainstorming session*	*Introduction to resume building*

Learning Resources	*1. Jeff Butterfield, Soft Skills for Everyone, CENGAGE, India, 2015* *2. Dr. K. Alex, Soft Skills, S.Chand Publishing & Company, India, 2014* *3. Covey Sean, Seven habits of highly effective teens, Simon &Schuster, New York, 2014*	*4. Carnegie Dale, How to win friends and influence people, Simon and Schuster, New York, 2016* *5. Thomas A Harris, I am ok, you are ok, Arrow, London, 2012* *6. Daniel Coleman , Emotional Intelligence , Bloomsbury, India, 2016*

Learning Assessment

	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-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**
Ajay Zener, Director, Career Launcher	-	*MrPriyanand, Assistant Professor, CDC, E&T, SRMIST*
		Ms Sindhu Thomas, Head in charge, CDC, FSH, SRMIST
		Ms Mahalakshmi, Assistant Professor, CDC, FSH, SRMIST

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SEMESTER II

Course Code	ULT20G02J	Course Name	Tamil-II	Course Category	G	Generic Elective Course	L	T	P	C
							2	0	2	3

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*To generate in students a sensitivity to gender marginalization and Eco sensitivity.*			
CLR-2 :	*An evolved consciousness in the minds to accommodate all is developed*			
CLR-3 :	*The ability to accept all and to co- exist is initiated*			
CLR-4 :	*To create community connectivity and interdependence is initiated*			
CLR-5 :	*To instill language skills*			
CLR-6 :	*To give them all the historical insights*			

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 acquire knowledge about Tamil Language*	*2*	*75*	*60*
CLO-2 :	*To strengthen the knowledge on concept, culture, civilization and translation of Tamil*	*2*	*80*	*70*
CLO-3 :	*To develop content using the features in Tamil language*	*2*	*70*	*65*
CLO-4 :	*To use Tamil Language and Literature to enhance their creativity*	*2*	*70*	*70*
CLO-5 :	*To improve communication and creative expression in Tamil language*	*2*	*80*	*70*
CLO-6 :	To enable the students to speak and write in chaste Tamil	*2*	*75*	*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*	*-*	*-*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*
CLO-2 :	*-*	*H*	*-*	*H*	*H*	*H*	*H*	*-*	*-*	*H*	*H*	*H*	*H*	*H*	*H*
CLO-3 :	*H*	*-*	*-*	*H*	*-*	*H*	*H*	*H*	*-*	*H*	*H*	*H*	*H*	*H*	*H*
CLO-4 :	*H*	*-*	*H*	*M*	*H*	*-*	*-*	*-*	*H*	*H*	*H*	*H*	*H*	*H*	*H*
CLO-5 :	*-*	*H*	*-*	*H*	*-*	*H*	*H*	*-*	*-*	*H*	*H*	*H*	*H*	*H*	*H*
CLO-6 :	*H*	*H*	*H*	*H-*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*

Duration (hour)		12	12	12	12	12
S-1	SLO-1	தமிழில்காலந் தோறும்அகமரபு	களப்பிரர்காலம்	பல்லவர்காலம்	சங்ககாலவரலாறு	தமிழ்ச்சிறுகதைப் போக்குகள்
	SLO-2	அகஇலக்கியப் போக்குகள்	அறமும்வாழ்வியலும்	பல்லவர்கால இலக்கியம்	சங்ககாலமக்களின் வாழ்வியல்	தமிழ்ச்சிறுகதையும்தமிழ்ச் சமூகவாழ்வியலும்
S-2	SLO-1	எட்டுத்தொகைநூல்களும் பெயர்களும்	திருக்குறள் - உலகப்பொதுமறை	பக்தியும்தமிழும்	முச்சங்கம் – அறிமுகம்	புதுமைப்பித்தன்- அகல்யை
	SLO-2	எட்டுத் தொகை யில்அகநூல்கள்	திருக்குறள் கட்டமைப்பு	பக்திஇலக்கியங்கள்	முச்சங்கவரலாறு	தொன்மம் – கட்டுடைப்பு
S-3	SLO-1	ஐங்குறுநூறு (203)	தமிழில்வினை	சைவசமய இலக்கியங்கள்	செம்மொழிஇலக்கியங்கள்	அகிலன் - ஒருவேளைச்சோறு
	SLO-2	தலைவனின் நாட்டுப்பெருமை	திருக்குறள் - வினைத்திட்பம் (67)	தேவாரமூவர்	பாட்டும்தொகையும்	தொழிற்புரட்சியும் விவசாயமும்
S-4	SLO-1	குறுந்தொகை (130)	உழவும்தமிழர்வாழ்வும்	தேவாரம் – திருஞானசம்பந்தர்பாடல்	எட்டுத்தொகைஉருவாக்கப் பின்புலம்	ஆண்டாள்பிரியதர்ஷினி – மாத்திரை
	SLO-2	அகவாழ்வில் நம்பிக்கைவேர்கள்	திருக்குறள் - உழவு (104)	தேவாரம் – திருநாவுக்கரசர்பாடல்	எட்டுத்தொகையும்தமிழர் வாழ்வியலும்	குடும்பம் – கட்டமைப்பு
S-5	SLO-1	பண்டைத் தமிழரின் வாழ்வியல்	சமணசமய இலக்கியங்கள்	திருவாசகம்அறிமுகம்	பத்துப்பாட்டுஉருவாக்கப் பின்புலம்	பாரததேவி- மாப்பிள்ளைவிருந்து
	SLO-2	பண்டைத்தமிழர் உணர்வியல்	நாலடியார்	மாணிக்கவாசகர் பாடல்	பத்துப்பாட்டும்தமிழர் வாழ்வியலும்	எளியமனிதர்களின்கதை
S-6	SLO-1	அகநானூறு (44)	இலக்கியங்களில்நட்பு	வைணவசமய வளர்ச்சிப்போக்கு	பதினெண்கீழ்க்கணக்கு நூல்கள்	சிங்காரவடிவேலு – தவிப்பு
	SLO-2	புறவாழ்வோடு கூடியஅகம்	நட்பில்பிழை பொறுத்தல் (221)	வைணவசமய இலக்கியங்கள்	பதினெண்கீழ்க்கணக்கும் தமிழர்அறமரபும்	புறக்கணிப்பின்வலி
S-7	SLO-1	கற்றறிந்தார்ஏத்தும்கலி	தமிழர்மருத்துவம்	நாலாயிரத்திவ்யப்பிரபந்தம்	நீதிஇலக்கியங்கள்	செய்திஅறிக்கைஅறிமுகம்
	SLO-2	கலித்தொகைகட்டமைப்பு	நீதிஇலக்கியத்தில்மருத்துவநூல்கள்	பெரியாழ்வார்பாடல்	நீதிஇலக்கியங்களின்பன்முகத்தன்மைகள்	செய்திஅறிக்கை தயாரித்தல்
S-8	SLO-1	கலித்தொகை (149)	திரிகடுகம்	ஆண்டாள்பாடல்	காப்பியஇலக்கணம்	விமர்சனம்
	SLO-2	வாழ்வியல்அறமும் அகமும்	செங்கோல்அரசு	தொண்டரடிப்பொடிஆழ்வார்பாடல்	காப்பியப்போக்குகள்	இலக்கியம், கலைவிமர்சனம்
S-9	SLO-1	தமிழர்புறமரபு	இனியவைநாற்பதுஅறிமுகம்	தமிழில்இஸ்லாமியஇலக்கியங்கள்	ஐம்பெருங்காப்பியங்கள்	நேர்காணல்அறிமுகம்

	SLO-2	புறஇலக்கியங்கள்	இனியவைநாற்பதின்தனித்தன்மைகள்	இஸ்லாமியஇலக்கியங்களின்கொடை	ஐம்பெருங்காப்பியங்களின்சிறப்புகள்	நேர்காணல் – நுட்பங்கள்
S-10	SLO-1	புறநானூறு (235)	இனியவைநாற்பது (14)	சீறாப்புராணம்	தமிழ்ச்சமூகமும்சமயத்தத்துவங்களும்	நேர்காணல்கேள்விதயாரிப்பு
	SLO-2	கையறுநிலை	இனிமையும்அழகும்	மானுக்குப்பிணைநின்றபடலம் (5 பாடல்கள்)	சமயத்தத்துவங்களும்வாழ்வியல்விழுமியங்களும்	நேர்காணல்பதிவும்எழுதுமுறையும்
S-11	SLO-1	ஆற்றுப்படைஅறிமுகம்	பண்டைக்காலப்போரும்வாழ்வும்	கிறித்தவசமயஇலக்கியங்கள்	பன்னிருதிருமுறை – அறிமுகம்	பேச்சுக்கலைஅறிமுகம்
	SLO-2	ஆற்றுப்படைமரபுகள்	போர்இலக்கியங்கள்	கிறித்தவஇலக்கியங்களின்கொடை	பன்னிருதிருமுறை – வரலாறு	தமிழரின்பேச்சுக்கலை
S-12	SLO-1	சிறுபாணாற்றுப்படை	களவழிநாற்பது (14)	ஆதிநந்தாவனப்பிரளயம்	நாலாயிரத்திவ்யப்பிரபந்தம் – அறிமுகம்	பேச்சுக்கலையின்வகைகள்
	SLO-2	நல்லியக்கோடனும்பாணர்வாழ்வியலும்	தமிழர்வீரம்	ஏதேன்தோட்டவருணனை	பன்னிருஆழ்வார்கள்வரலாறு	பேச்சுப்பயிற்சி

Learning Resources

1. மௌவல், தொகுப்பும்பதிப்பும் - தமிழ்த்துறைஆசிரியர்கள், தமிழ்த்துறை, எஸ்.ஆர்.எம். அறிவியல்மற்றும்தொழில்நுட்பக்கல்விநிறுவனம், காட்டாங்குளத்தூர், **603203, 2020.**
2. தமிழண்ணல், புதியநோக்கில்தமிழ்இலக்கியவரலாறு, மீனாட்சிபுத்தகநிலையம், மதுரை, 2017
3. மு. அருணாசலம், தமிழ்இலக்கியவரலாறு, நூற்றாண்டுமுறை(9ஆம்நூ. முதல் 16 வரை), திபார்க்கர், சென்னை, 2005
4. தமிழ்இணையக்கல்விக்கழகம் - **http://www.tamilvu.org/**
5. மதுரைதமிழ்இலக்கியமின்தொகுப்புத்திட்டம் - **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%	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	Expert from Higher Technical Institutions	Internal Experts
	1. Dr. R..Srinivasan, Associate Professor, Department of Tamil, Presidency College, Chennai.	*1. B.Jaiganesh, Assistant Professor & Head, FSH, SRMIST*
		2. T.R.HebzibahBeulahSuganthi, Assistant Professor, FSH, SRMIST
		3.S.Saraswathy, Assistant Professor, FSH, SRMIST

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Course Code	ULH20G02J	Course Name	Hindi-II	Course Category	G	Generic Elective Course	L	T	P	C
							2	0	2	3

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

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

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 acquire knowledge about Medieval and Modern Poetry.*	*2*	*75*	*60*
CLO-2 :	*To consider the relevance of the present trends in Hindi and their contemporary relevance.*	*2*	*80*	*70*
CLO-3 :	*To help develop better understanding of the Hindi language by studying the stories with reference to current reality.*	*2*	*70*	*65*

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
H	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-
-	*H*	-	*H*	-	-	-	-	-	-	-	-	-	-	-
H	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-

CLO-4 :	*To understand the usage of the present Advertising trends and its creative angles with the varied skills of Hindi Language.*	*2*	*70*	*70*	*H*	-	*H*	*H*	*H*	-	-	-	-	-	*H*	-	-	-	-
CLO-5 :	*To make translation of good literature and any relevant document from the Hindi Language to English and Vice-versa.*	*2*	*80*	*70*	-	*H*	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	*To help the learner to tackle Administrative terminologies, help them use Idioms and Phrases in their daily life, with ease.*	*2*	*75*	*70*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		**12**	**12**	12	**12**	**12**
S-1	**SLO-1**	Kavyekeguno se awagatkarana - Jaysi	Kahani Idkiyan	VIGYAPAN	ANUVAD	TaknikiShabdavali
	SLO-2	Ishkhakikievammoksh bhava se awagatkarana	Nari Shakti kisarthakata	Srijnatamakkshmatajagritkarna	Vidhyarthiyon ko sikhayajayegaanuvadkitnaupyogihai	Vaigniktarike se bhashaon ka avishkaarkarna
S-2	**SLO-1**	Surdas – Vatsalyaras se awagatkarana	Kahani gunda Prem kiprakashtha se awagatkarvana	VIGYAPAN KYA HAI	ARTH	ARTH
	SLO-2	Bhakti Bhavna se vidhyarthiyon ko jodna	Prtantrbharatkisamajikvyavstha se awagatkarvana	Shabdavalievamchitratamakta se awagatkarvana	Vidhyarthiyondwaraarthsmajkarsamajkeliyemahtavpurn karyakarpayenge	Vidhyarthiuskearthdwara hi uskemahtavsmjhenge
S-3	**SLO-1**	Tulsidas-Manav mulyonkiprabalbhavnajagritkarna	KAHANI KE TATVA	VIGYAPAN KI BHASHA	PARIBHASHA	PARIBHASHA
	SLO-2	DharmikParvarti se awagat karana	Kahani ketatvakimahatta se awagatkarvana	Bhasha kiabhivyaktikepryog ko smjhana	Vibhinnvidwanodwara di gai paribhasha se us baat ko smjhengevidhyathi	Vibhinnvidwanodwara di gai paribhasha se us baat ko smjhengevidhyathi
S-4	**SLO-1**	Tiruvaluvaar – naitikmulyon ko jagritkarna	KAHANI KE AAYAM	VIGYAPAN KA PRBHAV	MAHATVA	SHABDAVALI KI AVSHYAKTA
	SLO-2	Vidhyarthiyon ko nitivaanbnana	Vidhyarthiyon ko kahanikevidhinnayam se awagatkarvana	Shravaya-drishyasamgrikeprbhavkiupyogita	Samijikjan-jeevankeliyeanuvadkemahtav ko smjhana.	Vaignikon ka awiskarkitnamahtavpurn
S-5	**SLO-1**	Desh prem kibhavnabharna	LEKHAK PARICHAY	VIGYAPAN AUR BAZAR	UDDESHYA	BHASHA VAIGYANIK
	SLO-2	Krantikarivicharon se Awagatkarana	Lekhakokejivan se awagatkarvana	Vidhyarthioyon ko vigyapan se bazar me kaisesthapitkiya ja skatahaibatana	Vidhyarthianuvadkeuddeshya ko smajhkarsamajupyogikaryakrne me apnisarthakbhumikanibhayenge	Bhasha vaignikonkijankari
S-6	**SLO-1**	Badal Raag- Desh prem kibhavnabhrna	KAHANI PATH	VIGYAPAN AUR ROZGAR	HINDI-ENGLISH	KARYALYIN SHABD
	SLO-2	Krantikarivicharo se awagatkarana	Vidhyarthiyon ko kahani path kedwaraunkavakkausalmajbutkarna	Vidhyarthisavam ka ad-ajencybhibnapaye	Hindi adhikaraiauranuvadakke pad keliyetayaarkarna	Shabdkaisetayarkiyejatehainvidhyorthiyon ko jankari
S-7	**SLO-1**	Pret ka Byaan - Bhukhmarievamakaal se awagatkarana	KAHANI KA SARANSH	VIGYAPAN KI NIYAM	ENGLISH-HINDI	ANGREZI SE HINDI ANUVAD
	SLO-2	Samajiksamantabanayerkhne kipravartijagana	Lekhankshmata ka vikashona	Vigyapan ka ek hi niyam bhasha ka kashav jo vidhyarthiyon me viksitkiyajayega	Hindi adhikaraiauranuvadakke pad keliyetayaarkarna	Hindi adhikaraiauranuvadakke pad keliyetayaarkarna
S-8	**SLO-1**	Lahro se dark a naukapaarnhihoti –chatro ko sahashibnana	KAHANI KA UDDESHYA	VIGYAPAN KA MAHTVA	ANUVAD KI UPYOGITA	HINDI SE ANGREZI ANUVAD
	SLO-2	Karmaththapurnbhavna ko jagritkarna	Kahani keuddeshyunkejiwankemahtav ko smjhne me sahaykbanna	Vartman me uskiprasangiktavidhyarthiyon ko smjhana	Vidhyarthiyon ko vibhinkaryalayon me hindiadhikari pad kijankaripraptt	Hindi adhikariauranuvadakke pad keliyetayaarkarna.
S-9	**SLO-1**	Javani –rashtr prem kibhavnajagritkarna	KAHANI KA VISHELESHAN	PRINT VIGYAPAN	ANUVADk KI BHUMIKA	EK DIN EK SHABD
	SLO-2	Virrasevamvirtakipravati se awagatkarana	Vishleshankshmataviksitho ta	Vidhyarthiiski bhasha sikhenge	Vidhyarthiyon ko anuvadakkibhumika ka mahtavsmajhaayegajiskeadhar par vokaamkarenge	Vidhyarthiyon ko rozgaar se jodna
S-10	**SLO-1**	Dhool-samanvyavharkipravartijagana	KAHANI PARICHARCHA	RADIO, TV.VIGYAPAN	SAHITYIK ANUVAD	PRYOJANMULAK SHABD KA MAHTAVA
	SLO-2	Satah se juderahnekeprernadena.	Vaad-vivad se vidhyarthiyon me apnibaat ko rkhnekiyogyatabanna	Vidhyarthiyon ko abhyaskarvayajayega	Vibhinnbhashaonke sahitya ka anuvadkaisekiya jane kichunouti ko samjajhpayenge	Vidhyarthiyon ko vaighnikodwaratayaarki gai bhasha kisamaj
S-11	**SLO-1**	KAVYA BIBM	KAHANI ANDOLAN	Ad agency	ANUVAD KE NIYAM	VIBHINN KSHETRO ME PRYOJANMULAK SHABDO KA MAHATAV
	SLO-2	Vidhyarthiyon ko naye-nayebibmkijankaripraptthona	Vibhinnkahaniandolan se bhiawagatkarana	Ad agency aurswarozgaar se jodna	Anuvadkeniyamo ko vidhyarthismajhpayenge	Hindi adhikari pad par karyarat
S-12	**SLO-1**	SAMUHIK PARICHARCHA	KAHANI KA BADLTA SWAROOP	VIGYAPAN KA SWARUP	SHABDO KA MAHATAV	VAIGYANIK SHABDAVALI KI AVSHYAKATA
	SLO-2	Vidhyarthiyonkibolnekikausha lkshamta ko bdhana	Smaykesathunkeswarupke bdlav ka bhividyarthi me samajhpaidahona	Vidhyarthiyon ko vigyapanlekhakibarikayonkisamajh utpannhona	Shabdaanuvadkemahtva ko vidhyarthismajhenge	Vidhyarthiyon ko shabdokivaignikta se jodna

Learning Resources	1. ***The Prescribe Text Book Compiled and Edited by Department of Hindi*** 2. *www.kavitakosh.org* 3. *www.shabdkosh.com*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	30%	30%	30%	30%	20%	20%	20%	20%	30%	-
	Understand										
Level 2	Apply	40%	40%	50%	50%	50%	50%	50%	50%	50%	-
	Analyze										
Level 3	Evaluate	30%	30%	20%	20%	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
	Prof.(Dr.) S.Narayan Raju, Head, Department of Hindi,CUTN, Tamilnadu	*Dr.SPreeti. Associate Professor & Head, SRMIST*
		Dr. Md.S. Islam Assistant Professor, SRMIST
		Dr. S. Razia Begum, Assistant Professor, SRM IST

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Course Code	ULF20G02J	Course Name	French-II	Course Category	G	Generic Elective Course	L	T	P	C
							2	0	2	3

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	Strengthen the language of the students both in oral and written
CLR-2 :	Express their sentiments, emotions and opinions, reacting to information, situations
CLR-3 :	Make them learn the basic rules of French Grammar.
CLR-4 :	Develop strategies of comprehension of texts of different origin
CLR-5 :	Enable the students to overcome the fear of speaking a foreign language and take position as a foreigner speaking French
CLR-6 :	*Extend and expand their savoir-faire through the acquisition of current scenario*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*To acquire knowledge about French language*	*2*	*75*	*60*
CLO-2 :	*To strengthen the knowledge on concept, culture, civilization and translation of French*	*2*	*80*	*70*
CLO-3 :	*To develop content using the features in French language*	*2*	*70*	*65*
CLO-4 :	*To interpret the French language into other language*	*2*	*70*	*70*
CLO-5 :	*To improve the communication, intercultural elements in French language*	*2*	*80*	*70*
CLO-6 :	To enable the students to overcome the fear of speaking a foreign language and take position as a foreigner speaking French	*2*	*75*	*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
H	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-
-	*H*	-	*H*	-	-	-	-	-	-	*M*	-	-	-	-
H	-	-	*H*	-	-	-	-	-	-	*H*	-	-	-	-
H	-	*H*	*H*	*H*	-	-	-	-	-	*H*	-	-	-	-
-	*H*	-	*H*	-	-	-	-	-	-	*H*	-	-	-	-
H	-	*M-*	*H*	*H*	-	-	-	-	-	-	-	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	**Les loisirs**	**La routine**	**Où faire ses courses ?**	**Découvrez et dégustez**	**Tout le monde s'amuse**
	SLO-2	**Les activités**	**Les exemples**	**Les courses**	**Dégustez**	**Le monde**
S-2	SLO-1	Les activités quotidiennes	Les adjectifs interrogatifs	Les aliments	Les articles partitifs	Les sorties
	SLO-2	Les quotidiennes	Les trois formes	Les exemples	Du, De la, De l', Des	Les exemples
S-3	SLO-1	Les matières	Les nombres ordinaux	Les quantités	Le pronom en (la quantité)	Situer dans le temps
	SLO-2	Les exemples	Les nombres	Les exemples	Le bon quantité	Les activités
S-4	SLO-1	Le temps	L'heure	Les commerces	Très ?	Les vêtements
	SLO-2	L'heure	Quelle heure est-il ?	Les activités	Beaucoup ?	Les accessoires
S-5	SLO-1	Les fréquences	Le pronom personnel COD	Les commerçants	La phrase négative (2)	**Les ados au quotidien**
	SLO-2	Les activités	Les exemples	Les exemples	Les négations	**La vie quotidienne**
S-6	SLO-1	Les sons [u]	Les pronominaux	Demander le prix	C'est /Il est	Les adjectifs démonstratifs
	SLO-2	Les sons [y]	Se promener, se coucher etc…,	Dire le prix	Les activités	Ce, Cet, Cette, Ces
S-7	SLO-1	Les loisirs	Les verbes du premier groupe	Les services	L'impératif	La formation du féminin

	SLO-2	Les exemples	Parler, Demander, Poser	Les exemples	Les exemples	Les exemples
S-8	**SLO-1**	La routine	groupe en –e_er,é_er,-eler,-eter	Les moyens de paiement	Les verbes devoir, pouvoir	Le pronom indéfini on
	SLO-2	Les activités	Appeler, Jeter etc..,	La carte de crédits	Les verbes savoir, vouloir	Les activités
S-9	**SLO-1**	Les Mots	Le verbe prendre	les sons [ã]	Il faut	Le futur proche
	SLO-2	Les expressions	Les exemples	Les sons [an]	Le verbe impersonnel	S+Aller+Infinitif du verbe
S-10	**SLO-1**	Exprimer ses gouts	Parler de ses gouts	Découvrez !	Au restaurant : Commander et commenter	Le passe composé
	SLO-2	Les exemples	Des gouter	Dégustez !	Les restaurant	Les exemples
S-11	**SLO-1**	Exprimer ses préférences	Parler de ses préférences	Au restaurant : commander	Inviter à une invitation	Les verbes voir et sortir
	SLO-2	Les activités	Les exemples	Au restaurant : commenter	Répondre à une invitation	Décrire une tenue
S-12	**SLO-1**	Décrire sa journée	Décrire sa journée	Inviter à une invitation	Les Mots	écrire un message amical
	SLO-2	Les exemples	Les activités	Répondre à une invitation	Les expressions	Lire un message

Learning Resources	***Theory:*** 1. "**Génération-AI"** Méthode de français, Marie-Noëlle COCTON, P.DAUDA, L.GIACHINO, C.BARACCO, Les éditions Didier, Paris, 2018. ***2.Cahier d'activités avec deux discs compacts.***

Learning Assesment

	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%	40%	50%	50%	50%	50%	50%	50%	50%	-
	Analyze										
Level 3	Evaluate	30%	30%	20%	20%	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. C.Thirumurugan Associate Professor, Department of French, Pondicherry University	*1. Kumaravel K. Assistant Professor & Head, SRMIST*
		2. Ponrajadurai M Assistant Professor, SRMIST

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Course Code	UPY20201J	Course Name	Electricity and Magnetism	Course Category	C	Core Course	L	T	P	C
							4	0	4	6

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	*Understand how electromagnetic interactions can be understood using forces and fields*
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.*
CLR-6:	*Use basic experiments on electricity to understand the behavior of fields and currents.*

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 electromagnetic interaction in terms of forces and fields.*	2	80	75
CLO-2:	*Apply mathematical tools to explain electromagnetic interactions.*	2	80	70
CLO-3:	*Solve problems in engineering related to charges and currents.*	2	75	70
CLO-4:	*Solve problems in electromagnetism that require numerical approach.*	2	80	75
CLO-5:	*Device and run experiments based on demonstration of electromagnetic phenomenon.*	2	80	70
CLO-6:	*Apply the knowledge of electricity and magnetism to understand energy propagation in the form of radiation.*	2	80	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	PSO - 1	PSO - 2	PSO - 3
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H

Duration (hour)		24	24	24	24	24
S-1	SLO-1	Physical meaning of derivatives	Coulomb's law	Uniqueness theorems	Biot Savart law, magnetic field due to steady straight-line currents	Ohm's law
	SLO-2	Physical meaning of gradient	E field of discrete charge distributions	Method of images for calculating potentials	Divergence of magnetic field	Emf and motional emf
S-2	SLO-1	Geometrical interpretations of divergence and curl	E field of continuous charge distribution	Method of images for calculating potentials	Curl of magnetic field and Ampere's law	Faraday's law and induced electric field
	SLO-2	Geometrical interpretations of divergence and curl	Problem solving on E field of discrete charge distributions	Numerical problems to calculate potential of systems using method of images	Numerical problem solving on magnetic field due to various current densities	Numerical problems in Faraday's law
S-3	SLO-1	Line and surface integrals	Problem solving on E field of continuous charge distributions	Dielectrics and induced dipoles	Applications of Ampere's law	Energy in magnetic fields
	SLO-2	Numerical evaluation of line and surface integrals of vector fields	Divergence of electrostatic field	Polarization and bound charges	Applications of Ampere's law	Energy in magnetic fields
S-4	SLO-1	Volume integral	Gauss's law and its importance	Physical interpretation of bound charges	Field due to solenoid	Maxwell's modification of Ampere's law
	SLO-2	Numerical evaluation of volume integral	How Gauss's law simplifies electrostatic problems	Numerical problems to calculate electric field of uniformly polarized sphere.	Numerical problem solving on the applications of Ampere's law. Current loop and solenoid.	Simple numerical problem on displacement energy in magnetic field
S-5 to S-8	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-9	SLO-1	Geometrical interpretation of fundamental theorem on gradients	Applications of Gauss's law	Field inside a dielectric	Comparison of electrostatics and magnetostatics	Displacement current
	SLO-2	Geometrical interpretation of fundamental theorem on divergences	Problems involving Gauss's law to calculate electrostatic fields	Gauss's law in the presence of dielectrics and electric displacement	Magnetic vector potential	Maxwell's equations in matter
S-10	SLO-1	Geometrical interpretation of fundamental theorem on curls.	Problems involving Gauss's law to calculate electrostatic fields	Boundary conditions	Magnetostatic boundary conditions	Boundary conditions
	SLO-2	Numerical problems in all 3 fundamental theorems.	Curl of Electrostatic field	Calculating the electric field of dielectric objects using Gauss's law	Simple problem in calculation of vector potential	Simple numerical problem on displacement current
S-11	SLO-1	Numerical problems in all 3 fundamental theorems.	Conservative nature of electrostatic field and scalar electric potential	Susceptibility, permittivity and dielectric constant	Magnetization	Sinusoidal waves
	SLO-2	Spherical polar coordinate system (SPC)	Importance of scalar electric potential.	Susceptibility tensor	torque and force on magnetic dipoles	Complex notation of sinusoidal waves
S-12	SLO-1	Calculate the volume of sphere in SPC	Boundary conditions	Force on dielectric in a capacitor	torque and force on magnetic dipoles	Transverse and longitudinal polarization
	SLO-2	Cylindrical polar coordinate system (CCS)	Numerical problem solving on line integral of electrostatic field and potential	Numerical on force on dielectric in capacitor	Numerical problem solving on torque and force on magnetic dipoles	Numerical problems for testing wave functions obeying wave equation
S-13 to S-16	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-17	SLO-1	Calculate the volume of a cylinder in CCS.	Poisson's and Laplace's equations	Current and magnetic field	Field of a magnetized object	The wave equation for E and B in vacuum
	SLO-2	Dirac Delta function, Importance of Dirac delta function in electrostatics	Potential of localized charge distribution	Magnetic force: Lorentz force law	Bound currents and its physical interpretation	Solution of the wave equation
S-18	SLO-1	One dimensional Dirac delta function	Energy of a point charge distribution	Cycloid motion	Ampere's law in magnetized materials	Transverse nature of EM waves
	SLO-2	Numerical problem solving on evaluating integrals containing Dirac delta function	Numerical problems involving potential of localized charge distributions.	Numerical problem solving on magnetic force and cycloid motion	One basic numerical problem on the field due to a magnetized object	Simple problems that relate the amplitude of the fields of an EM wave, direction of the fields and propagation direction.
S-19	SLO-1	Equations for Gradient, divergence and curl in SPC and CC.	Energy of a continuous charge distribution	Line, surface and volume current densities	Magnetic susceptibility and permeability	Energy and momentum in EM waves
	SLO-2	Helmoltz theorem and potentials	Conductors placed in electrostatic fields, capacitors	Law of conservation of charges and continuity equation	Ferromagnetism	Continuity equation,Poynting's theorem
S-20	SLO-1	Scalar and vector potentials	Laplace's equation in 1D, 2D and 3D	Steady currents and continuity equation	Magnetic domains	Poynting vector and intensity of EM waves
	SLO-2	Numerical problems involving fields and potentials	Finding the electric field due to charged conducting objects	Numerical problem solving on calculating current and current densities	One numerical problem: Field of a solenoid filled with magnetic material	Numerical problem solving on Poynting vector and intensity of EM waves
S-21 to S-24	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	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %
	Understand										
Level 2	Apply	40 %	40 %	40 %	40 %	40 %	40 %	40 %	40 %	40 %	40 %
	Analyze										
Level 3	Evaluate	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

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

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Course Code	UPY20202T	Course Name	Mathematical Physics	Course Category	C	Core Course	L	T	P	C
							4	2	0	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		
		1	2	3
CLR-1:	*Gain knowledge on matrix operations and eigenvalue problems*			
CLR-2:	*Understand linear differential and partial differential equations and its applications*			
CLR-3:	*Improve the concept on vector algebra to understand the flow fields*			
CLR-4:	*Build knowledge on complex functions and its analysis*			
CLR-5:	*Acquire basic concepts on periodic and non-periodic functions in order to understand the time series*			
CLR-6:	*Develop sound knowledge on application of mathematics to understand the problems in 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:	*Apply the matrix method and its properties to solve various problems*	2	80	75
CLO-2:	*Use differential equations to describe the changes in the field variables*	2	80	70
CLO-3:	*Express the three-dimensional field variables in simple way using vector analysis and understand its characteristics*	2	75	70
CLO-4:	*Analyze different kinds of physical problems (such as potential theory, response theory etc.) using concept of complex variables*	2	80	75
CLO-5:	*Separate the periodic and non-periodic functions and solve the problems of involving time series using Fourier transformations*	2	80	70
CLO-6:	*Have clear concept on mathematical skills to understand theoretical of physics*	2	80	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	PSO - 1	PSO - 2	PSO - 3
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H

Duration (hour)		18	18	18	18	18
S-1	SLO-1	Matrix Multiplication	Definition of differential equation	Review of vector algebra	Analytic function	Periodic function
	SLO-2	Simultaneous Linear Equations	Degree and order	Vector triple product	Differentiation and analyticity	Odd and even functions
S-2	SLO-1	Definition of matrix	Formation of differential equation	Introduction to vector calculus	Cauchy-Riemann equation [CRE]	Square and Triangular wave
	SLO-2	Classification of matrices	Linear differential equation	Vector Differentiation	Proof of CRE	Saw-Tooth wave
S-3	SLO-1	Basic Matrix operations	Equation reducible to linear form	Introduction to Del operator	Analytic to harmonic function	Euler formula for Fourier series
	SLO-2	Complex conjugation and transposition	Bernoulli's equation	Physical meaning for Del operator	Harmonic Function	Euler coefficient
S-4	SLO-1	Trace of a matrix and its properties	Exact differential equation	Gradient of Scalar field	Milne Thompsons [MT]equation	Fourier series with 2l period
	SLO-2	Determinant and its properties	Condition for exactness	Physical meaning of gradient	Construction of M-T equation	Connection between Fourier series with different periods
S-5	SLO-1	Problem solving on matrix operations	Problem solving on degree and order	Problem solving on del operator	Problem solving on Differentiability	Problem solving on periodicity
	SLO-2	Problem solving on Trace	Problem solving on formation of differential equation	Problem solving on vectors	Problem solving on Analyticity	Problem solving on odd, even function
S-6	SLO-1	Problem solving on Determinants	Problem solving on linear differential equation	Problem solving on gradients	Problem solving on CRE	Problem solving on Fourier series

	SLO-2	Problem solving on transposition and conjugation	Problem solving on exact differential equation	Above continued	Problem solving on Harmonic function	Problem solving on Euler coefficients
S-7	SLO-1	Definition of Inverse matrix	Leibnitz's differential equation	Divergence of vector field	Conformal mapping	Perseval's Identity
	SLO-2	Algorithm to find Inverse matrix	General method of solution	Physical meaning of divergence	Bilinear Transformation	Proof of Perseval's Identity
S-8	SLO-1	Symmetric and skew-symmetric matrix	First order differential equations	Curl of vector field	Special cases of Bilinear	Fourier integral Theorem
	SLO-2	Hermitian and Skew-Hermitian matrix	First order differential equations solvable for y	Physical meaning of curl	Inversion and rotation	Proof of Integral theorem
S-9	SLO-1	Orthogonal matrix	Clairut's differential equation	Gauss' divergence theorem	Line integration complex function	Motivation for Fourier transform
	SLO-2	Unitary matrix	Singular solution	Application of divergence theorem	Line integration in Vector calculus	Definition of Fourier transform
S-10	SLO-1	Eigenvalues and eigenvectors	Homogeneous Second order Differential equation	Stokes' Curl theorem	Cauchy Integral formula	Properties of Fourier transform
	SLO-2	Characteristic equation	Complementary function	Application of Curl theorem	Proof of Integral formula	Linearity and shifting
S-11	SLO-1	Problems on Inverse matrix calculation	Problem solving on first order	Problem solving on Divergence	Problem solving on Integral Theorem	Problem solving on transform finding
	SLO-2	Problem solving on Inverse matrix calculation	Problem solving on Clairut's equation	Problem solving on curl	Problem solving on Integral Theorem	Problem solving on transform finding
S-12	SLO-1	Problem solving on Hermitian matrix	Problems to find complementary function	Problem solving on verification of divergence theorem	Taylor's Series	Problem solving on integral theorem
	SLO-2	Problem solving on Unitary Matrix	Problems to find complementary function	Problem solving on verification of curl theorem	Laurent's Series	Problem solving on integral theorem
S-13	SLO-1	Cayley –Hamilton theorem Proof	Particular integral [introduction]	Green's theorem	Singularity	Transform-change of scale
	SLO-2	Cayley –Hamilton theorem Proof	General method to find the Particular integral	Application of Green's theorem	Classification of singularities	Modulation
S-14	SLO-1	Diagonalization of matrix	Non-homogeneous differential equation	Path independence	Cauchy residue theorem	Fourier transform of derivatives
	SLO-2	Theorems related to Diagonalization	Operator factorization method	Conservative field	Proof of Residue theorem	Fourier transform of derivatives
S-15	SLO-1	Definition of vector space	Non-homogenous differential equation variable coefficient;	Introduction to Frenet-Serret formulae	Review of Cauchy Integral formula	Convolution theorem
	SLO-2	Examples of vector space	Non-homogenous differential equation variable coefficient;	Application of Frenet-Serret formulae	Review of Cauchy Integral Theorem	Proof of convolution
S-16	SLO-1	Linear Independence	Introduction to partial differential equation (PDE)	Importance of Vector identity	Review of Taylor's series	Inverse Fourier transform
	SLO-2	Normal matrices	Formation of PDE	Proof of identity	Review of residue theorem	Bromwitch formula
S-17	SLO-1	Problems related to Cayley theorem	Problems based factorization method	Problem solving on conservative field	Problem solving on Taylor's series	Problem solving on convolution
	SLO-2	Problem solving on diagonalization	Problems based factorization method	Problem solving on potential function	Problem solving on Laurent's series	Problem solving on convolution
S-18	SLO-1	Problems related to linear independence	Problems based on degree and order of PDE	Problem solving on green's theorem Verification	Problem solving on residue integral	Problem solving on inverse Fourier transform
	SLO-2	Problem solving on finding Rank	Problems of forming PDE	Problem solving on Frenet-Serret formulae	Problem solving on residue integral	Problem solving on inverse Fourier transform

Learning Resources	1. Mathematical Physics, Satya Prakash, (Sultan Chand and Sons, Reprint 2016). 2. Advanced Engineering Mathematics, Erwin Kreyszig, (10th Edition, Willey 2011). 3. Schaum's Outline of Vector Analysis, Spiegel M R, (McGraw–Hill Education,2009). 4. Higher Engineering Mathematics, Grewal B.S, (Khanna Publications, 42nd Edition,2012). 5. Vector Spaces And Matrices In Physics, Jain M C, (Narosa,2007).

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember / Understand	30 %	-	30 %	-	30 %	-	30 %	-	30 %	-
Level 2	Apply / Analyze	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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Course Code	UMA20A02T	Course Name	Allied Mathematics-II	Course Category	G	Generic Elective Course	L	T	P	C
							3	0	0	3

Pre-requisite Courses	UMA20A01T	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Mathematics	Data Book / Codes/Standards			

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	To understand the basics of integration.
CLR-2 :	To learn the fundamental concept of Trigonometry.
CLR-3 :	Understand to solve ordinary differential equations.
CLR-4 :	To understand concepts of Laplace Transform and its properties.
CLR-5 :	To learn the concepts of inverse Laplace Transform.

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 (%)	Scientific 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 :	Students will able to apply the concepts of integral calculus, in finding area, surfaces, volume of the solid.	3	85	80	H	H	L	-	-	-	-	-	M	L	-	H	-	-	-
CLO-2 :	Students will able to be familiar with Trigonometry.	3	85	80	M	H	-	M	M	-	-	-	M	-	-	H	-	-	-
CLO-3 :	Students will understand the concept of second order differential equations with constant coefficient and applying in mechanics and dynamics.	3	85	80	H	H	-		-	-	-	-	M	-	-	H	-	-	-
CLO-4 :	Students are able to understand the concept of Laplace transformation and applying in Science and Engineering	3	85	80	H	H	H	M	-	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Students are able to understand the concept of Inverse Laplace transformation and applying in Science and Engineering.	3	85	80	M	H	L	-	-	-	-	-	M	-	-	H	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Integral calculus-Basic integral formulae.	Expansion of $\sin n\theta, \cos n\theta$ in powers of $\sin\theta$ and $\cos\theta$, where n being a positive integer.	Introduction to second order differential equations with constant coefficients.	Introduction to Laplace Transforms	Introduction t Inverse Laplace Transforms
	SLO-2	Problems related to integral formulae.	Expansion of $\tan n\theta$.	Finding the order and degree of the differential equations.	Standard results of Laplace transforms	Standard results of Inverse Laplace transforms
S-2	SLO-1	Integrals of the type $\int \frac{dx}{ax^2+bx+c}$	Problems based on $\sin n\theta$	Solution of the differential equation – Complementary function and particular function.	Derivation of the standard results of Laplace transforms.	Simple problems based on results.
	SLO-2	Problems related to the above integral type.	Problems based on $\sin n\theta$	Problems based on $(aD^2+bD+c)y=0$	Derivation of the standard results of Laplace transforms.	Simple problems based on results.
S-3	SLO-1	Integrals of the type $\int \frac{px+q}{ax^2+bx+c}dx$	Additional problems based on $\sin n\theta$	Additional problems on $(aD^2+bD+c)y=0$	Simple problems based on results.	Simple problems based on results.
	SLO-2	Problems related to the above integral type.	Problems based on $\cos n\theta$	Problems based on $(aD^2+bD+c)y=e^{ax}$	Simple problems based on results.	Simple problems based on results.
S-4	SLO-1	Integrals of the type $\int \frac{dx}{\sqrt{ax^2+bx+c}}$	Problems based on $\cos n\theta$	Additional problems on $(aD^2+bD+c)y=e^{ax}$	Properties of Laplace Transforms.	Simple problems based on results.
	SLO-2	Problems related to the above integral type.	Additional problems based on $\cos n\theta$	Problems based on $(aD^2+bD+c)y=\sin ax$	Properties of Laplace Transforms.	Inverse Laplace transforms of $sF(s)$
S-5	SLO-1	Integrals of the type $\int \frac{px+q}{\sqrt{ax^2+bx+c}}dx$	Problems based on $\cos n\theta$ and $\tan n\theta$	Problems based on $(aD^2+bD+c)y=\sin ax$	Problems related to the properties of Laplace transforms.	Problems based on $L^{-1}[sF(s)]$
	SLO-2	Problems related to the above integral type.	Expansion of $\sin^n\theta$ and $\cos^n\theta$ interms of multiples of $\sin\theta$ and $\cos\theta$ where n being a positive integer.	Additional problems based on $(aD^2+bD+c)y=\sin ax$	Problems related to the properties of Laplace transforms.	Additional problems on $L^{-1}[sF(s)]$
S-6	SLO-1	Integration by Partial fraction method (Simple algebraic functions only)	Problems based on $\sin^n\theta$ interms of $\sin\theta$.	Additional problems based on $(aD^2+bD+c)y=\sin ax$	Additional problems related to the first shifting property.	Inverse Laplace transforms of $\frac{F(s)}{s}$

	SLO-2	Problems related to the partial fraction method.	Problems based on $\sin^n\theta$ interms of $\cos\theta$.	Problems based on $(aD^2+bD+c)y=\cos ax$	Laplace transform of $tf(t)$	Problems based on $L^{-1}\left[\frac{F(s)}{s}\right]$
S-7	SLO-1	Additional problems related to the partial fraction method.	Problems based on $\sin^n\theta$ interms of $\cos\theta$.	Additional problems based on $(aD^2+bD+c)y=\cos ax$	Problems on Laplace transform of $tf(t)$	Additional problems based on $L^{-1}\left[\frac{F(s)}{s}\right]$
	SLO-2	Bernoulli's formula and related problems.	Problems based on $\cos^n\theta$ interms of $\cos\theta$.	Additional problems based on $(aD^2+bD+c)y=\cos ax$	Problems on Laplace transform of $\frac{f(t)}{t}$	Inverse Laplace transforms - partial fraction method
S-8	SLO-1	Reduction formula for $\int \sin^n x\,dx$	Problems based on $\cos^n\theta$ interms of $\cos\theta$.	Problems based on $(aD^2+bD+c)y=x^n$	Additional problems on Laplace transform of $\frac{f(t)}{t}$	Partial fraction method-Related problems.
	SLO-2	Evaluation of $\int_0^{\frac{\pi}{2}} \sin^n x\,dx$	Problems based on $\sin^n\theta\ \cos^n\theta$ interms of multiples of $\sin\theta$ and $\cos\theta$	Additional problems on $(aD^2+bD+c)y=x^n$	Problems on Laplace transform of $te^{at}f(t)$	Additional problems on partial fraction method.
S-9	SLO-1	Reduction formula for $\int \cos^n x\,dx$	Problems based on $\sin^n\theta\ \cos^n\theta$ interms of multiples of $\sin\theta$ and $\cos\theta$	Additional problems on $(aD^2+bD+c)y=x^n$	Additional problems on Laplace transform of $te^{at}f(t)$	Additional problems on partial fraction method.
	SLO-2	Evaluation of $\int_0^{\frac{\pi}{2}} \cos^n x\,dx$	Problems based on $\sin^n\theta\ \cos^n\theta$ interms of multiples of $\sin\theta$ and $\cos\theta$	Additional problems on $(aD^2+bD+c)y=x^n$	Additional problems on Laplace transform of $te^{at}f(t)$	Additional problems on partial fraction method.

Learning Resources

1. Singaravelu. A, Allied Mathematics, 6th Revised Edition, Meenakshi Agency, 2014.
2. Vittal. P.R, Allied Mathematics, 4th Edition Reprint, Margham Publications, 2013.
3. Venkatachalapathy, S.G, Allied Mathematics, 1st Edition Reprint, Margham Publications, 2007.
4. T.K. Manickavasagam Pillai and S. Narayanan, Ancillary Mathematics, Reprint, S.Viswanathan Printers and Publishers Pvt. Ltd., Chennai.
5. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons. Singapore, 10th edition, 2012.
6. T. Veerajan, "Engineering Mathematics I", Tata McGraw Hill Publishing Co., New Delhi, 5th edition, 2006.
7. B.S. Grewal, Higher Engineering Mathematics, Khanna Publications, 42nd 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 / Understand	40 %	-	30 %	-	30 %	-	30 %	-	30 %	-
Level 2	Apply / Analyze	40 %	-	40 %	-	40 %	-	40 %	-	40 %	-
Level 3	Evaluate / Create	20 %	-	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
Mr. V. Maheshwaran, Cognizant Technology Solutions maheshwaranv@yahoo.com	Prof. Y.V.S.S. Sanyasiraju, IIT Madras, sryedida@iitm.ac.in	Dr. A. Govindarajan, SRMIST Dr. N. Parvathi, SRMIST
	Prof. B. V. Rathish Kumar, IIT Kanpur, bvrk@iitk.ac.in	Mr. M. Balaganesan, SRMIST Dr. T. Nirmala, SRMIST Mrs.T.N.Saibhavani, SRMIST

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Course Code	UCD20S02L	Course Name	Quantitative Aptitude and Reasoning	Course Category	S	Skill Enhancement Course	L	T	P	C
							0	0	2	1

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Career Development Centre*	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			
CLR-2 :	Develop interest and awareness in students regarding profit/ loss, interest calculations and average			
CLR-3 :	Critically evaluate basic mathematical concepts related to mixtures and alligations, permutation and combination, time and work			
CLR-4 :	Provide students with skills necessary to generate and interpret data and concepts related to time, speed and distance and blood relation.			
CLR-5 :	Enable students to understand reasoning skills			
CLR-6 :	Create awareness in students regarding the various concepts in quantitative aptitude and reasoning skills and also its importance in various competitive exams			

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 :	Understand, analyze and solve questions based on numbers, logarithms.	3	80	70	H	H	M	H	L	M	-	H	-	H	-	H	M	-	H
CLO-2 :	Create, solve, interpret and apply basic mathematical models which are applicable in our day to day life	3	80	75	M	H	M	H	-	M	-	H	-	H	-	H	M	-	H
CLO-3 :	Understand the concepts of mixtures and alligations, permutation and combinations, probability, time and work and to approach questions in a simpler and innovative method	3	85	70	M	H	M	H	-	M	-	H	-	H	-	H	M	-	H
CLO-4 :	Understand the concept in time ,speed and distance	3	85	80	M	H	M	H	-	M	-	H	-	H	-	H	M	-	H
CLO-5 :	Ability to solve the problems on reasoning	3	85	75	M	H	M	H	-	M	-	H	-	H	-	H	M	-	H
CLO-6 :	Able to face different competitive exams	3	80	70	M	H	M	H	-	M	-	H	-	M	-	H	M	-	H

Duration (hour)		6	6	6	6	6
S-1	SLO-1	Classification of numbers	Profit and Loss-Introduction	Mixtures and Alligations-Introduction	Time, Speed and Distance-Problems on Trains	Direction Sense-Introduction
	SLO-2	Test of divisibility	Profit and Loss- Basic Problems	Mixtures and Alligations-Problems	Time, Speed and Distance-Boats & Streams	Direction Sense-Problems
S-2	SLO-1	Unit digit	Statistics-Introduction	Permutation –Introduction& Basics	Data Interpretation – Bar chart	Number Series
	SLO-2	Tailed zeroes	Statistics-Mean, Median, Mode	Combination-Introduction& Basics	Data Interpretation – Pie chart	Word Series
S-3	SLO-1	HCF, LCM	Simple Interest-Introduction,Formulas&Problems	Probability-Introduction &Basics	Data Interpretation – Table	Seating Arrangements - Linear
	SLO-2	HCF, LCM - Solving problems	Compound Interest-Introduction ,Formulas&Problems	Probability-Problems	Data Interpretation – Line graph	Seating Arrangements - Circular
S-4	SLO-1	Logarithm –Introduction of log rules	Word problems on Line equations-Introduction	Time and work-Introduction	Data sufficiency-Introduction and Basics	Puzzles-Concepts
	SLO-2	Logarithm –Applications of log rules	Word problems on Line equations-Basic problems	Time and work-Men and Work	Data sufficiency-Problems	Puzzles-Problems
S-5	SLO-1	Percentage -Introduction	Averages-Introduction & Basics	Time and work-Pipes &Cisterns(Introduction)	Blood relation-Introduction	Clocks-Concepts Discussion
	SLO-2	Percentage- Basic problems	Averages-Tricky Problems	Time and work-Pipes &Cisterns(Problems)	Blood relation-Problems	Clocks-Problems
S-6	SLO-1	Percentage-Increasing & Decreasing functions	Ratio and Proportions-Introduction	Time, Speed and Distance-Introduction	Coding – Decoding-Introduction	Calendars-Introduction of basic concept
	SLO-2	Percentage- Miscellaneous problems	Ratio and Proportions-Basics & problems	Time, Speed and Distance-Basic problems	Coding – Decoding-Different types	Calendars-Problems

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, PlaceMentor: Tests of Aptitude for Placement Readiness, Oxford University Press, Oxford, 2018	4. Edgar Thrope, Test Of Reasoning for Competitive Examinations, Tata McGraw Hill, 6th Edition 5. Dinesh Khattar, The Pearson Guide to Quantitative Aptitude for competitive examinations, Pearson, 3rd Edition *6. P A Anand, Quantitative Aptitude for competitive examinations, Wiley publications, e book, 2019*

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-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**
Ajay Zener, Director, Career Launcher	-	*Dr. P Madhusoodhanan, HoD, CDC, E&T, SRMIST*
		Dr. M Snehalatha, Assistant. Professor, CDC, E&T, SRMIST

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Course Code	**UJK20201L**	**Course Name**	**Communication Skills**	**Course Category**	**JK**	**Life Skill Course**	**L**	**T**	**P**	**C**
							0	**0**	**4**	**2**

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

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

		1	2	3
CLR-1 :	*To make the students learn the native speakers' accent.*			
CLR-2 :	*To educate them about word stress of English*			
CLR-3 :	*The enable them to participate in group discussion and debates*			
CLR-4 :	To improve their participation and participation skills			
CLR-5 :	To improve the listening and speaking abilities in English			
CLR-6 :	*LSRW skills all together is developed in every student*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	1 Fundamental Knowledge	2 Application of Concepts	3 Link with Related Disciplines	4 Procedural Knowledge	5 Skills in Specialization	6 Ability to Utilize Knowledge	7 Skills in Modeling	8 Analyze, Interpret Data	9 Investigative Skills	10 Problem Solving Skills	11 Communication Skills	12 Analytical Skills	13 PSO -1	14 PSO -2	15 PSO-3
CLO-1 :	*Understand the native speakers' exact pronunciation*	*2*	*75*	*60*	*H*	*H*	*H*	*H*	-	-	-	*H*	*H*	*H*	*H*	*H*	-	-	-
CLO-2 :	*Master the sound systems of English*	*2*	*80*	*70*	*H*	*H*	*H*	-	-	-	-	*H*	*H*	*H*	*H*	*H*	-	-	-
CLO-3 :	*Have a better Word stress, Rhythm and Intonation*	*2*	*70*	*65*	*H*	*H*	*H*	-	*H*	*H*	-	-	*H*	*H*	*H*	*H*	-	-	-
CLO-4 :	*Develop Neutral Accent*	*2*	*70*	*70*	*H*	*H*	*H*	-	*H*	-	-	-	-	-	*H*	*H*	-	-	-
CLO-5 :	*Participate in any conversation with any native speaker*	*2*	*80*	*70*	*H*	*H*	-	*H*	-	*H*	-	*H*	*H*	*H*	*H*	*H*	-	-	-
CLO-6 :	*Clear any standardized tests conducted to measure the English language ability like IELTS and TOEFL*	*2*	*75*	*70*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	-

Duration (hour)		12	12	12	12	12
S-1	**SLO-1**	Introduction to Digital language lab - helps in the listening skills by providing an interactive environment to the students	*Learners are enabled to record their speech and listen to it in order to correct their lacuna*	*Reading software is used to facilitate reading exercises for the students*	*To enable the students to familiarize with word processor blogging*	Students are enabled to learn and pronounce stressed and unstressed words
	SLO- 2	The students will be able to converse fluently	*One will know himself where he/ she has gone wrong*	*Flow in reading will be improved*	*online publishing. Will be learnt by the students*	The practice will lead them to acquire neutral accent and understand foreign accent
S-2	**SLO-1**	*Students are exposed to functionallanguage*	*Fluency and Pronunciation to be evaluated*	*The usage of phonetics will be mandated.*	Enable the students in learning situational language	Common topics in IELTS speaking test and TOFEL will be provided to assess the students.
	SLO- 2	*This exposurewill help thempick up fluency*	*Their standard will measured*	*reading will be done in the class*	Create imaginary situations and students are allowed to engage in conversations	Assessments will be provided for self scrutiny
S-3 – S-4	**SLO-1**	*Lab 1 In the wall of Pink Floyed to be played for the students*	*Lab 4 Students are given a situation, they need to write a respond for it by writing a letter requesting information or explaining the situation*	*Lab 7 Introduction to the conversation of a native speaker/ interview of a native speaker*	*Lab 10* learners are asked to describe some visual information(table/charts/nature) in their own word	*Lab 13students will listen to a passage and they need to give a suitable title*
	SLO- 2	*The students will be able to understand the isolation of a wall. It helps them to enhance their pronunciation*	*This will lead to understand the English letter conventions*	*Learners will prove the fluency by listening*	*They need to have a well organized thought of it using language accurately in a academic style.*	Assessment on their language competency and vocabulary
S-5	**SLO-1**	*They get familiarized with pronunciation styles*	*Learners to record and repeat new wordsagain and again*	*New words are to be referred in the reading passages and checked with the help of dictionaries*	*Familiarize the students with e-journals , e-guidance, e-magazines, e-Books, e-Library*	Listening topics in the IELTS listening test and TOFEL will be provided
	SLO- 2	*American and British styles are differentiated*	*Untill right prononciation isaquiredis not allowed to go to the Next session*	*Those new words are to be used in different contexts and sentences*	*Help students to access them as much as possible*	Assessment on their listening capacity is to be provided
S-6	**SLO-1**	*Listening to news bulletins and songswillbeenabled to help them to understand use of vocabulary*	*Learnerscanspeak English and compare the notes and exchange ideas*	*Comprehensive skills are enhanced and checked the level*	Enable the students to versatile writing	Reading topics in the IELTS reading test and TOFEL will be provided to assess the students.

	SLO- 2	*Will beenabled ti imitae the exact accent and prononciation*	*From the exchangedideascomprehensive questions willbeasked by the otherstudents*	*The levels are informed to the students and Icuna is explained*	Diffrerence in writing and readingisexplained	Assesment on their capacity is explained
S-7 – S-8	**SLO-1**	*Lab 2TedX will be played for the student*	*Lab 5 introduction to semi-formal/ neutral discursive essay will be taught.*	*Lab 8 television news will be broadcasted to them*	*Lab 11learners are given with a set of images where they need to write a story from it*	*Lab 14 students will listen to the great monologues of the time*
	SLO- 2	*It will help them to improve their fluency*	*It will teach them to write coherently and cohesively.*	*It will help them to understand the usage of words and the fluency of speaker*	*It helps them to keen on observation as well as to know their creativity.*	They will learn the importance of pronunciation, stress and pause in a speech
S-9	**SLO-1**	*To enable to listen to authentic sounds of the target language*	*Give different topics to debate to enable them talk fluently*	*The right pronunciation is checked with an access to articles fiction verses and speeches*	*Focus on writing is done*	writing topics in the IELTS writing test and TOFEL will be provided to assess the students.
	SLO- 2	*To enable them imitate the different sounds and accents and make them repeat it*	*To check the pace of their speech*	*Minute details and differences are marked and rectified*	*Conversational skills are enhanced*	Writing skills are assessed and tested
S-10	**SLO-1**	To enable to practice different accents focusing on intonation and voice modulation	*Dialogue delivery be checked by asking them to prepare for their own e-learning materials*	*Read and repeat passages*	Help in professionalwriting	Model IELTS and TOFEL test will be conducted for the students
	SLO- 2	The differences between intonation stress and modulations are explained	*Make the students speak and record*	*Check the ability to repeat the exact pronounciation*	Check and asses theirwritings	Assessment will be provided to the learners
S 11 - S 12	**SLO-1**	*Lab3 After listening to TedX, students need to jot down set of question.*	*Lab 6 learners will be taught to write a review for a film after watching*	*Lab 9 conversation between two people in every day context will be played for the studetns*	*Lab 12 students will listen to the writers note on publishing a novel/ short story*	*Lab 15 they will listen to grammar usage in the form of visual image and song*
	SLO- 2	This will help them to identify the key information in listening text.	*Leaner will need to think for the apt word. Through this language competency will be evaluated*	*It Will help them to understand the targetlanguage*	It willhelpsthem to enhancetheircreativityalso the language compétence	They will the foreign language easily and it enhances their competency of it

Learning Resources	***Theory:*** 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%)#	
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	-	30%	-	30%	-	30%	-	30%
	Understand								
Level 2	Apply	-	30%	-	30%	-	30%	-	30%
	Analyze								
Level 3	Evaluate	-	40%	-	40%	-	40%	-	40%
	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.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
	1. Prof. Daniel David, Prof & Head, Department of English, MCC, Chennai	*1. Dr. Shanthichitra, Associate Professor, & Head, Department of English, FSH,SRMIST*
		2. Dr K B Geetha, Assistant Professor, Department of English, FSH, SRMIST

COMMUNICATION SKILLS

(UJK20201T**)**

FACULTY OF SCIENCE AND HUMANITIES

SRMIST

SYLLABUS

Communication plays an important role in shaping an individual's life, personal as well as professional; also, it is the backbone of any organization/ institution. Success in life to a considerable extent depends on effective communication skills. In today's world of computers and digital media, a strong communication skill base is essential for learners and for smooth functioning of an organization.

Objectives:

This course has been developed with the following objective:

1. Identify common communication problems that may be holding learners back
2. Identify what their non-verbal messages are communicating to others
3. Understand role of communication in teaching learning process
4. Learning to communicate through the digital media
5. Understand the importance of empathetic learning
6. Explore communication beyond language

Expected outcome:

By the end of this program participants should have a clear understanding of what good communication skills are and what they can do to improve their abilities.

Credit: 02

UNIT I

Listening

- Techniques of effective listening
- Listening and comprehension
- Probing questions
- Barriers to listening

Speaking

- Pronunciation
- Enunciation
- Vocabulary
- Fluency
- Common Errors

UNIT II

Reading

- Techniques of effective reading
- Gathering ideas and information from a given text
    I. Identify the main claim of the text
    II. Identify the purpose of the text
    III. Identify the context of the text
    IV. Identify the concepts mentioned
- Evaluating these ideas and information
    I. Identify the arguments employed in the text
    II. Indentify the theories employed or assumed in the text
- Interpret the text
    I. To understand what a text says
    II. To understand what a text does
    III. To understand what a text means

UNIT III

Writing and different modes of writing

- Clearly state the claims
- Avoid ambiguity, vagueness, unwanted generalizations and oversimplification of issues
- Provide background information
- Effectively argue the claim
- Provide evidence for the claim
- Use examples to explain concepts
- Follow convention
- Be properly sequenced
- Use proper signposting technique
- Be well structured
    I. Well-knit logical sequence
    II. Narrative sequence
    III. Category groupings
- Different modes of writing
    I. E-mails
    II. Proposal writing for higher studies
    III. Recording the proceedings of meeting
    IV. Any other mode of writing relevant for learners

UNIT IV

Digital Literacy

- Role of digital literacy in professional life
- Trends and opportunities in using digital technology in workplace
- Internet basics
- Introduction to MS Office tools
    I. Paint
    II. Office
    III. Excel

IV. Powerpoint

Effective use of social media

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

UNIT V

Non-verbal communication

- Meaning of non-verbal communication
- Introduction to modes of non-verbal communication
- Breaking the misbeliefs
- Open and closed body language
- Eye contact and facial expression
- Hand gestures
- Do's and don't
- Learning from experts
- Activities based learning

References for Pedagogy: Instructor – led training is expected and the pedagogy be supplemented by online platform like (SWAYAM) and other online learning facilities

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Course Code	UNS20201L UNC20201L UNO20201L UYG20201L	Course Name	NSS/NCC/NSO/YOGA	Course Category	EA	Extension Activity	L	T	P	C
							0	0	0	0

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

Assessment is Fully Internal

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

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Course Code	UPY20301J	Course Name	Heat and Thermodynamics	Course Category	C	Core Course	L	T	P	C
							4	0	4	6

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	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:	*Know the fundamentals of heat, specific heat of solids, liquids and gases*			
CLR-2:	*Understand the methods of transmission of heat and thermal conductivities*			
CLR-3:	*Realize the importance of kinetic theory of gases*			
CLR-4:	*Learn the laws of thermodynamics and its significance*			
CLR-5:	*Recognize the concepts of entropy*			
CLR-6:	*Learn the Maxwell's thermodynamical relations*			

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 methods to determine the specific heat capacities of solids, liquids and gases*	2	90	85	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-2:	*Grasp concepts of thermal conductivities in different media*	2	90	85	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-3:	*Realize the importance of black body radiation and its importance*	2	90	85	H	H	H	H	H	H	H	H	H	H	M	H	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	85	80	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-5:	*Familiarize with the laws of thermodynamics, entropy and its implications in real life applications*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-6:	*Recognize the significance of Maxwell's thermodynamical relations in thermal physics*	2	90	85	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H

Duration (hour)		24	24	24	24	24
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	Clausius Theorem
S-2	SLO-1	Newton's law of cooling –	Coefficient of the thermal conductivity	Degrees of freedom	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	Maxwell's law of equipartition of energy	Adiabatic process.	Second law of thermodynamics in terms of Entropy
S-3	SLO-1	Specific heat of a liquid – Joule's electrical method	Searle's method	Atomicity of gases – monoatomic gas	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	Searle's method	Atomicity of gases – diatomic and triatomic gases	Gas equation during an adiabatic process	Principle of Increase of Entropy -Unattainability of Absolute Zero
S-4	SLO-1	Specific heat of a liquid calendar and Barne's continuous flow method	Forbes' method to find K	Maxwell's law of distribution of molecular velocities	Work done during an Isothermal process	Change in entropy in a reversible process
	SLO-2	Specific heat of a liquid calendar and Barne's continuous flow method	Forbes' method to find K	Maxwell's law of distribution of molecular velocities - Equilibrium speed distribution of velocities	Work done during an Isothermal process	Change in entropy in an irreversible process
S-5 to S-8	SLO-1	Basics of Experiments	Determination of saturated vapour pressure of water at different temperatures using Joly's method.	Revision/Repeat classes	Determination of thermal conductivity of good conductors by Searle's method.	Determination of Planck's constant using black body radiation.
	SLO-2					
S-9	SLO-1	Introduction to specific heats of at constant pressure	Lee's disc method to find thermal conductivity of bad conductor	Experimental verification of molecular velocities	Work done during an adiabatic process	Entropy Vs Temp
	SLO-2	Introduction to specific heats of at constant volume	Lee's disc method to find thermal conductivity of bad conductor	Mean free path	Work done during an adiabatic process	Temperature entropy diagram
S-10	SLO-1	Cp,Cv relation	Methods of radial flow of heat Spherical shell method and flow of heat along the wall of a cylindrical tube	Determination of Mean free path	Determination of g by Clement and Desorme's method	Entropy of perfect gas
	SLO-2	Cp,Cv relation	Methods of radial flow of heat Spherical shell method and flow of heat along the wall of a cylindrical tube	Transport phenomena	Determination of g by Clement and Desorme's method	Thermodynamic Potentials: Internal Energy,
S-11	SLO-1	Specific heat of a gas at Cv by Jolly's differential steam calorimeter	Thermal conductivity of Rubber	Diffusion of gases	Reversible process	Enthalpy
	SLO-2	Specific heat of a gas at Cv by Jolly's differential steam calorimeter	Thermal conductivity of Glass	Viscosity of gases	Irreversible process	Helmholtz Free Energy,
S-12	SLO-1	Specific heat of a gas at Cp - Regnault's method	Radiation - Black body	Thermal conduction of gases	Second law of thermodynamics – Kelvin -Planck statement	Gibb's Free Energy
	SLO-2	Specific heat of a gas at Cp - Regnault's method	Black body	Brownian motion and its importance	Second law of thermodynamics – Clausius statement	First order phase transition

S-13 to S-16	**SLO-1**	Determination of Specific Heat Capacity of the liquid using Newton's Law of Cooling	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 Stefan's constant	Calculate the Temperature coefficient of resistance of the given coil by Carey Foster Bridge.
	SLO-2					
S-17	**SLO-1**	Specific heat of a gas at Cp – Continuous flow electrical method	Rayleigh's Law and its significance	Andrew's Experiments on CO_2 Gas- Critical Constants	Conversion of Work into Heat and Heat into Work	Second order phase transition
	SLO-2	Specific heat of a gas at Cp - Continuous flow electrical method	Jean's law	Andrew's Experiments on CO_2 Gas- Critical Constants	Heat Engines	Characteristics of Second order phase transition
S-18	**SLO-1**	Dulong and Petit's law	Wein's displacement Law	Van Der Waals equation of state	Concept of Carnot's engine	Maxwell's thermodynamical relations
	SLO-2	Dulong and Petit's law and its verification	Stefan's law	Van Der Waals equation of state	Carnot's cycle	Maxwell's thermodynamical relations-Significance
S-19	**SLO-1**	Variation of specific heat and atomic heat with temperature	Planck's law	Relation between Van der Waal's constant and critical constants	Working efficiency of Carnot's engine	Joule-Kelvin coefficient for Ideal and Van der Waal Gases
	SLO-2	Variation of specific heat and atomic heat with temperature	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-20	**SLO-1**	Einstein's theory of specific heat	Experimental Determination of Stefan's constant	Joule-Thomson Porous Plug Experiment	Carnot's refrigerator	Clausius and Clapeyron equation
	SLO-2	Debye's theory of specific heat	Mathematical derivation of Stefan's law	Joule-Thomson Porous Plug Experiment	Carnot's Theorem and its significance	Significance of Clausius and Clapeyron equation
S-21 to S-24	**SLO-1**	Determination of specific heat capacity of a liquid by continuous flow (Callender and Barnes) method.	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.	Study of the variation of thermo emf across two junctions of a thermocouple with temperature.	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	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %
	Understand										
Level 2	Apply	40 %	40 %	40 %	40 %	40 %	40 %	40 %	40 %	40 %	40 %
	Analyze										
Level 3	Evaluate	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

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

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Course Code	UPY20302T	Course Name	Quantum Mechanics	Course Category	C	Core Course	L	T	P	C
							4	2	0	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**		
		1	2	3
CLR-1:	*Learn the general formalism and the mathematical background of quantum theory*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2:	*Obtain analytical solutions of simple systems in one, two and three dimensions*			
CLR-3:	*Understand the postulates of quantum mechanics and the central concepts of wave functions and operators*			
CLR-4:	*Solve the time-dependent and time-independent Schrödinger equation for simple potentials*			
CLR-5:	*Know essential physical principles supported by mathematical developments*			
CLR-6:	*Understand the concepts of spin, angular momentum states, and fine structure*			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:				**Program Learning Outcomes (PLO)**														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO - 1	PSO - 2	PSO - 3
CLO-1:	*Apply principles of quantum mechanics to calculate observables on quantum measurements and uncertainty principle.*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-2:	*Solve simple three-dimensional quantum mechanical problems exactly by using quantum mechanical framework*	2	80	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-3:	*Relate the knowledge of mathematics to the formalism of quantum mechanics*	2	75	70	H	H	H	H	H	H	H	H	M	H	M	H	H	H	H

CLO-4:	*Identify and solve the eigenvalue problems for energy, momentum, angular momentum and explain the idea of spin*	2	80	75		H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-5:	*Gain experience with quantum mechanics for further studies in theoretical physics as well as nanotechnology*	2	80	70		H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-6:	*Use mathematical tools to construct approximate quantum mechanical problems and solve them*	2	80	75		H	H	H	H	H	H	H	H	H	H	M	H	H	H	H

Duration (hour)		**18**	**18**	**18**	**18**	**18**
S-1	**SLO-1**	Inadequacy of classical mechanics (CM)	Basic postulates of quantum mechanics	Barrier penetration problem	Schrödinger's Equation in 3D	Spin of an electron
	SLO-2	Birth of Quantum Mechanics (QM)	Linearity and Superposition principle	Introduction to step potentials and potential well	Schrödinger's Equation for Hydrogen Atom	Magnetic moment of an electron due to spin
S-2	**SLO-1**	Blackbody radiation	Schrodinger's equations: Time Dependent	Finite Potential well	Spherical Polar Co-ordinates	Stern-Gerlach experiment
	SLO-2	Rayleigh-Jeans Vs Planck' law	Time Independent equation	Comparison with particle in a box	Laplacian operator	Exclusion principle
S-3	**SLO-1**	Quantum theory of light	Eigen values and Eigen functions	Potential well Solution for Energy Eigen values	Schrödinger's Equation in Spherical polar co-ordinates	Symmetric and antisymmetric wave functions
	SLO-2	Electromagnetic spectrum	Hermitian operators and real eigenvalues	wave function penetration	Schrödinger's Equation for Hydrogen Atom in Spherical polar co-ordinates	Fermions and Bosons
S-4	**SLO-1**	Planck's Quantum and electromagnetic wave	Energy, Momentum and Hamiltonian Operators	Step Potential barrier	Separation of Variables	Orbital angular momentum
	SLO-2	Photo electric effect	Schrodinger's equation: Operator form	Wave functions at boundaries/interface	A differential equation for each variable for Hydrogen atom	Orbital magnetism and Bohr magneton
S-5	**SLO-1**	Problem solving: CM vs QM	Problem solving: Postulates of QM	Problem solving: potential well	Problem solving: Laplacian	Problem solving: Spin quantization
	SLO-2	Problem solving: Blackbody	Problem solving: Schrodinger's equations	Problem solving: penetration depth	Problem solving: Spherical polar coordinates	Problem solving: Symmetric/Antisymmetric wave functions
S-6	**SLO-1**	Problem solving: EM wave	Problem solving: Schrodinger's equations	Problem solving: step potential	Problem solving: Laplacian in spherical polar coordinates	Problem solving: Fermions/Bosons
	SLO-2	Problem solving: Photoelectric effect	Problem solving: Operators	Problem solving: boundary values	Problem solving: Hydrogen atom ground-state wave function	Problem solving: Orbital magnetic moment
S-7	**SLO-1**	Compton effect	Properties of wave function	Solution for Potential Barrier and exact treatment of wave function	Hydrogen atom: Quantum Numbers	Magnetic moment precession in a magnetic field
	SLO-2	Back-scattering	Conditions for Physical Acceptability of Wave Function	Transmission and reflection coefficients	Principal, Orbital and Magnetic Quantum Numbers	Larmor's precession
S-8	**SLO-1**	Wave nature of matter	The Born Interpretation of wave function	Tunneling of wave function (tunnel effect)	Hydrogen atom: Orbital quantum number	Magnetic potential energy
	SLO-2	de-Broglie hypothesis	Probability Density and physical significance of wavefunction	Transmission coefficient: Energy and width dependence	Quantization of angular-momentum magnitude	Normal Zeeman Effect
S-9	**SLO-1**	Davisson and Germer's experiment	Wavefunction for a Free Particle and wave equation	Scanning Tunneling Microscope (STM)	Hydrogen atom: Magnetic quantum number and Quantization of angular-momentum direction	Total angular momentum
	SLO-2	Electrons behave as waves	Expectation values of energy, momentum for free particle	STM: Principle and Working	Uncertainty Principle and Space Quantization	Quantum numbers J and J_z
S-10	**SLO-1**	Free particle wave function	Application of position-momentum uncertainty relation to free particle	Simple Harmonic Oscillator	Hydrogen atom stationary state wave functions	Spin-orbit interaction
	SLO-2	Wave packets	Classical particle in a box	Classical picture SHM	Shapes of the probability densities	Spin-orbit energy
S-11	**SLO-1**	Problem solving: Compton effect	Problem solving: Wavefunction properties	Problem solving: Step potential	Problem solving Space quantization	Problem solving: Larmor precession frequency calculation for electron
	SLO-2	Problem solving: wave nature de-Broglie hypothesis	Problem solving: Wavefunction Probability	Problem solving: Transmission coefficient	Problem solving: Hydrogen atom ground state energy calculation	Problem solving: Splitting of energy levels in Normal Zeeman effect
S-12	**SLO-1**	Problem solving: Wave groups and packets	Problem solving: Plane waves	Problem solving: wave function probability	Problem solving: Expectation value of potential energy and KE in hydrogen atom ground state	Problem solving: Total angular momentum
	SLO-2	Problem solving: Electron Scattering	Problem solving: Wavefunction Normalization	Problem solving: Transition Probability	Problem solving: Energy of hydrogen-like atoms	Problem solving: Spin-orbit interaction
S-13	**SLO-1**	Group and Phase velocities	Particle in an infinite square well	Quantum Harmonic Oscillator	Angular momentum operators	Lande g-factor
	SLO-2	Relationship between group, wave and particle velocity	Energy Eigen values	Ground state wave function	Schrodinger equation for hydrogen atom in terms of L^2	Spectroscopic notation extended to include spin
S-14	**SLO-1**	Heisenberg's Principle	Normalization and Orthogonality	Quantum Harmonic Oscillator Solution	Eigen values and Eigen functions of L^2	Degeneracy of States
	SLO-2	Alternative description for uncertainty	Normalization of Particle wave function	Energy Eigen values and zero-point energy	Eigen values and Eigen functions of L_z	Fine Structure
S-15	**SLO-1**	Energy time uncertainty relation	Interpretation of wave function	Quantum Harmonic Oscillator Wavefunctions versus Classical Picture	Hydrogen Atom: Eigen functions of H	Defining LS coupling and rules
	SLO-2	Application: electrons in nucleus	probability distributions and quantization	Quantum Harmonic Oscillator Probabilities	Hydrogen Atom: Eigen functions of L^2 , and L_z	Definition of JJ coupling
S-16	**SLO-1**	Thought experiment for Uncertainty Principle	Expectation values and relation with uncertainty principle	Position expectation for Harmonic Oscillator	Degeneracy of states	Exchange symmetry
	SLO-2	Gamma ray microscope	Example of Particle in a box	Uncertainty Principle and zero-point energy	Degeneracy of the energy Eigen values	Pauli's exclusion principle

S-17	SLO-1	Problem solving: wave packets	Problem solving: Wavefunction Normalization	Problem solving: Oscillator wave function	Problem solving: Expectation value of L_z in the ground state	Problem solving: Term symbols
	SLO-2	Problem solving: wave velocities	Problem solving: Particle in a box	Problem solving: energy Eigen values	Problem solving: Expectation value of L^2 in the ground state	Problem solving: LS coupling
S-18	SLO-1	Problem solving: uncertainty principle-1	Problem solving: Expectation values	Problem solving: expectation values	Problem solving: Normalization of hydrogen atom ground state wave function	Problem solving: JJ coupling
	SLO-2	Problem solving: uncertainty principle-2	Problem solving: Probability Distributions	Problem solving: zero-point energy	Problem solving: Degeneracy	Problem solving: Fine structure

Learning Resources	1. Concepts of Modern Physics, Arthur Beiser (McGraw Hill, 2009) 2. Quantum Mechanics, G Aruldhas, (Prentice Hall, 2008) 3. Introductory Quantum Mechanics, R. L. Liboff (Addison-Wesley, 2003)	4. Introduction to Quantum Mechanics, D. J. Griffiths (Pearson Education Inc. 2005) 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)

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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Course Code	UPY20303J	Course Name	Analog and Digital Electronics	Course Category	C	Core Course	L	T	P	C
							4	0	4	6

Pre-requisite Courses	Nil	**Co-requisite Courses**	Nil	**Progressive Courses**	Nil
Course Offering Department	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 concept of networks and semiconductors*			
CLR-2:	*Understand the working principles of a transistors*			
CLR-3:	*Familiarize the operation of amplifiers and oscillators*			
CLR-4:	*Understand the basic concepts of number systems*			
CLR-5:	*Develop the digital circuit design concepts using logic gates*			
CLR-6:	*Apply digital fundamentals in combinational and sequential logic systems*			

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 skills to solve the circuits*	2	80	75
CLO-2:	*Enable the students to explore the field of transistors*	2	80	70
CLO-3:	*Understand the concepts and working principles in amplifiers and oscillators*	2	75	70
CLO-4:	*Apply the concepts of number system in digital electronics*	2	80	75
CLO-5:	*Understands the basic concepts of logic gates*	2	80	70
CLO-6:	*Utilize the concepts in logic systems*	2	80	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	PSO - 1	PSO - 2	PSO - 3
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H

Duration (hour)		24	24	24	24	24
S-1	SLO-1	Circuit elements	RC coupled single stage amplifier-Construction	Operational Amplifiers (op-amp),	Introduction to Decimal number systems	Half adder
	SLO-2	Kirchhoff's Laws	RC coupled single stage amplifier-Operation- Frequency response	Open loop and closed loop op-amp characteristics	Binary number systems	Full adders
S-2	SLO-1	Methods of analyzing circuits-Mesh and Nodal Method	Introduction to power amplifiers	Ideal op-amp with virtual ground	Octal number systems	Half subtractor
	SLO-2	Thevenin's Theorem	Classification of power amplifiers	Inverting op-amp	Hexadecimal number systems	Full subtractor
S-3	SLO-1	Norton's theorem	Class A amplifier	Non-inverting op-amp	Binary Coded Decimal (BCD) code	Two's complement adder circuits
	SLO-2	Intrinsic and Extrinsic semiconductor	Class A amplifier: Construction/Working	Op-amp Adder	Excess –3 code	Two's complement subtractor circuits

S-4	**SLO-1**	PN junction diode–construction	Class B amplifier	Op-amp Subtractor	Gray code	Binary Coded Decimal (BCD) adder
	SLO-2	Biasing of PN junction- VI characteristics of diode	Class B amplifier: Construction/Working	Op-amp Voltage follower	Gray code to Binary code conversion	Decoder
S-5 To S-8	**SLO-1**	Basic Experimentations – Demo class	Obtain the characteristics curves of BJT in CE Configuration	Revision/Repeat classes	Verification of truth tables using logic gates	Design of Half adder, Full adder, Half subtractor and Full subtractor using logic gates
	SLO-2					
S-9	**SLO-1**	Zener Diode-VI Characteristics	Class AB amplifier	Op-amp as comparator	One's complement and two's complement	Encoder
	SLO-2	Solving Problems on Zener diode as voltage regulator	Solving problems on power amplifier efficiency	Solving problems on Op-amp applications	Binary Addition	Multiplexer and problem solving
S-10	**SLO-1**	Bipolar Junction Transistors-	Class C amplifier	Op-amp as intergrator, differentiator	Binary Subtraction and solving problems on binary arithmetic	Demultiplexer
	SLO-2	BJT: Construction/Working	Class C amplifier: Construction/Working	Clipping circuits-Positive clipper	Basic and derived logic gates– Symbols and their truth tables– AND–OR– NOT	RS flip-flop
S-11	**SLO-1**	CE Configuration	Class A Push pull amplifier	Negative clipper	Basic and derived logic gates– Symbols and their truth tables– AND–OR– NOT	Clocked RS flip-flop
	SLO-2	CE-input and output characteristics	Class A Push pull amplifier: Construction/Working	Biased clipper	NAND– NOR logic gates	D flip-flop
S-12	**SLO-1**	CB Configuration	Class B Push pull amplifier	Combination clipper	XOR– XNOR logic gates	JK flip-flop
	SLO-2	CB-input and output characteristics	Class B Push pull amplifier	Applications of clipper	Universal logic gates-NAND and NOR	Master slave JK flip-flop
S-13 To S-16	**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 of Hartley Oscillator	NAND and NOR gates as Universal logic gates	Design of Decade counter and count table verification
	SLO-2					
S-17	**SLO-1**	Introduction to Two port networks	Oscillator operations- Barkhausen criteria	Basic idea of a clamper	Basic laws of Boolean algebra	Shift left registers
	SLO-2	Two port network analysis and problem solving	Feedback amplifiers	Positive clamper	De– Morgan's theorems and problem solving	Shift right registers
S-18	**SLO-1**	FET – Construction	Types of feedback and problem solving on feedback	negative clamper and problem solving	Reducing Boolean expressions using Boolean laws	SISO Shift register
	SLO-2	Characteristics of JFET	Principle of oscillators	IC555 (Timer IC)	Sum of Products (SOP) form of expressions	SIPO Shift register
S-19	**SLO-1**	Biasing of JFET	Hartley's oscillator	Astable-multivibrator	Product of Sum (POS) form of expressions	Ripple counter
	SLO-2	Depletion and Enhancement Mode	Colpitt's oscillators	Astable-multivibrator	Min term and max terms	Ring counter
S-20	**SLO-1**	Depletion type MOSFET	Phase shift oscillator	Monostable-multivibrator	Karnaugh map simplification	Up and Down counter
	SLO-2	Enhancement type MOSFET	Wien's bridge oscillator	Monostable-multivibrator	Karnaugh map simplification	Decade counter
S-21 to S-24	**SLO-1**	Study the V–I characteristics of a 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.	Study of timer circuit using IC555 and configuration for monostable and astable-multivibrator.	Verification of truth tables of Flip-Flops	Revision/Repeat classes
	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. Digital Fundamentals, Thomas L. Floyd (Pearson Education, 9th Edition, 2006) 5. 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 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %
	Understand										
Level 2	Apply	40 %	40 %	40 %	40 %	40 %	40 %	40 %	40 %	40 %	40 %
	Analyze										
Level 3	Evaluate	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

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

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. M Satish, CSIR-CECRI, msathish@cecri.re.in	Prof. C Venkateshwaran, University of Madras, venkateshwaran@unom.ac.in	Dr. S. Yuvaraj, SRMIST
Dr. V. Jayaraman, IGCAR, Kalpakkam, vjram@igcar.gov.in	Dr. V Gunasekaran, Central University TN, gunasekaran@cutn.ac.in	Dr. A. Naga Rajesh, SRMIST

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Course Code	UPY20D01T	Course Name	Elements of Earth's Atmosphere	Course Category	D	Discipline Specific Elective Course	L	T	P	C
							4	2	0	6

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	*Acquire knowledge on the solar system and its role on the earth's atmosphere*
CLR-2:	*Understand the atmospheric measurement and their limitations*
CLR-3:	*Build the knowledge on the thermal structure of earth's atmosphere and its thermodynamical processes*
CLR-4:	*Understand the interaction between radiation various molecules and particles in the atmosphere*
CLR-5:	*Gain detailed knowledge on aerosols properties and their sources and sink*
CLR-6:	*Develop concepts on global climate classifications and climate change phenomena*

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:	*Get clear concept on earth's atmospheric systems and its processes*	2	80	75
CLO-2:	*Develop detailed knowledge on atmospheric thermodynamics*	2	80	70
CLO-3:	*Understand the components weather and climate systems*	2	75	70
CLO-4:	*Distinguish the natural and anthropogenic causes influencing the atmosphere*	2	80	75
CLO-5:	*Apply basic laws of physics to derive the atmospheric processes*	2	80	70
CLO-6:	*Develop concept on the global warming and climate change*	2	80	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	PSO - 1	PSO - 2	PSO - 3
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	M	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H

Duration (hour)		18	18	18	18	18
S-1	SLO-1	Structure of the solar system	Temperature variations –seasonal	Spectrum of radiation	Primary aerosols	Definition of climate
	SLO-2	Compositions and atmosphere of the planets	Temperature variations –Diurnal	Quantitative description of radiation	secondary aerosols	Global pattern of climate
S-2	SLO-1	Kepler's Laws of Planetary Motion	day time warming	Black body radiation	natural aerosols – examples	Climate Classification – Thoronthwaite approach – Moisture index
	SLO-2	Solar Energy	night time cooling	Plank Function	anthropogenic aerosols – examples	perhumid climates
S-3	SLO-1	Solar irradiance, insolation	the controls of temperature-latitude effect	Wien's displacement law	Classification of aerosols based on the size, nucleation etc.	Humid climates
	SLO-2	Solar constant, derivation of solar constant from Stefan Boltzman Law	elevation effect	the Stefan – Boltzman law	accumulation and coarse mode	semiarid and arid climates
S-4	SLO-1	Experiment for obtaining solar constant	water bodies effect	Radiative properties in non-black materials	formation processes of aerosols – gas to particle conversion	Koppen climate classification – Tropical climates
	SLO-2	solar radiation at the Earth's surface	proximity of sea	Kirchoff 's law	bulk to particle conversion	dry climates
S-5	SLO-1	Problem solving in solar constant	Problem solving in temperature effects	Problem solving in radiations laws	Problem solving in aerosol characteristics	Problem solving in climate approaches
	SLO-2	Exercises on experimental techniques on solar irradiances	Exercises on orographic effects of temperatures	Exercises in emission laws	Exercises on growth of aerosols	Exercises on different climates
S-6	SLO-1	AssignmentonKepler laws	Assignment on temperature controls	Assignment on EM spectrum	Assignment on classification	Assignment on Koppen climate
	SLO-2	Group discussion on solar systems	Group discussion on diurnal variations of temperature	Group discussion on solar energy	Group discussion on impact of aerosols	Group discussion on global climates
S-7	SLO-1	Earth energy budget	Circulation of water in the atmosphere –evaporation	Greenhouse effect	drop to particle conversion	Temperate climates
	SLO-2	Contributing factors	Condensation and saturation	Physics of scattering and absorption and emission	background of marine aerosols	continental climates
S-8	SLO-1	Incoming radiation	water vapor mixing ratio, absolute humidity	Scattering of air molecules	Sulphur cycle	polar climates
	SLO-2	outgoing radiation	specific humidity, actual vapor pressure, saturated vapor pressure	Scattering of particles	sulphate aerosols	Earth's changing climate -climate during last 100 years
S-9	SLO-1	Composition of earth atmosphere – primary constituents	relative humidity	absorption by particles	dust aerosols	global rainfall changes
	SLO-2	trace constituents- CO2	relation between water vapor mixing ratio and specific humidity	absorption by gas molecules	carbon aerosols	global temperature changes
S-10	SLO -1	water vapor, tropospheric ozone	saturated air	emission by gas molecules	urban aerosols	global CO2 changes
	SLO-2	Aerosols	dew point temperature	absorption continua	volcanic aerosols	possible causes of climate change
S-11	SLO-1	Problem solving on radiative balances	Problem solvingon vapor pressure	Problem solving in scattering and absorption	Problem solving in aerosol effects	Problem solving in climate effects
	SLO-2	Exercises in energy budget	Exercises on humidity variables	Exercises on molecule and particle scattering	Exercises in sulfur cycle	Exercises on global changes
S-12	SLO-1	Assignment on aerosols	Assignment on saturated vapor pressure	Assignment on emissions	Assignment on carbonaceous aerosols	Assignment on climate change causes
	SLO-2	Group discussion on components of earth's atmosphere	Group discussion on humidity	Group discussion absorption	Group discussion on marine aerosols	Group discussion on impacts of climate change

S-13	**SLO -1**	Thermal structure of atmosphere –Troposphere, stratosphere	Classification of clouds	absorption lines	high latitude atmospheric aerosols	climate change definition
	SLO-2	mesosphere and thermosphere,	cloud identification	broadening of absorption lines	global spatial avariability of aerosols	variations in earth's orbit
S-14	**SLO -1**	radiative equilibrium	clouds with vertical development	Beer's law	global temporal variability of aerosols	climate change and atmospheric particles
	SLO-2	temperature of the planet Earth	Atmospheric stability	Reflection and absorption by a layer of the atmosphere	Interaction between aerosols and minor gas components	global teleconnections – El Nino
S-15	**SLO -1**	Overview of atmospheric general circulation – ITCZ	dry and moist adiabatic lapse rates	Absorption and emission of infrared radiation	aerosol measurement characteristics- aerosol optical depth	La Nina
	SLO-2	Hadley Cell	unstable air	Schwarzschild's equation	angstrom exponents	carbon dioxide
S-16	**SLO -1**	Ferrell Cell	conditionally unstable air	vertical profiles of radiative heating rate	single scattering albedo	greenhouse gas effect
	SLO-2	Polar Cell	convection and clouds	radiative balance at the top of the atmosphere	asymmetry factor	global warming
S-17	**SLO -1**	Problem solving in scales of motion	Problem solving in lapse rates	Problem solving in emission laws	Problem solving in angstrom exponents	Problem solving in earth orbital effects
	SLO-2	Exercises on circulation	Exercises on stability	Exercises on heating rates	Exercises on aerosol measurements	Exercises on teleconnections
S-18	**SLO -1**	Onsite demonstration on automatic weather station – Weather parameters	Assignment on cloud growth	Assignment on radiations	Assignment on temporal variability of aerosols	Assignment on global warming
	SLO-2	Hands on analysis of weather charts	Demonstration on satellite data retrieval techniques	Demonstration on weather forecasting models	Hands on aerosol measurements	Onsite demonstration of trace gas measurements

Learning Resources

1. Essentials of Meteorology by C. Donald Ahrens and Brooks/Cole (Cengage Learning, 2008)
2. Atmospheric Science – An introductory Survey by John M Wallace and Peter V Hobbs (International Geophysics Series, 2006)
3. Fundamental of Atmospheric Physics, Murry L Salby, (Academic Press, Vol 61, 1996)
4. The Physics of Atmosphere, John T. Houghton, (Cambridge University press;3rdedn. 2002).
5. The Earth's Atmosphere, Its Physics and Dynamics, KshudiramSaha (Springer, 2008)

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember / 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
Mr. R Seshadri, Titan Company Limited, seshadri@titan.co.in	Dr. D Paul Joseph, NIT Warangal, paul@nitw.ac.in	Dr. TV Lakshamikumar, SRMIST
Dr. Ashok, ISRO, ashok@vssc.gov.in	Dr. CV Naidu, Andhra University, cvnaidu.metro@auvsp.edu.in	Dr. Sanjay K Mehta, SRMIST

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Course Code	UPY20D02T	Course Name	Solar Technology	Course Category	D	Discipline Specific Elective Course	L	T	P	C
							4	2	0	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:
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*
CLR-6:	*Gain a fundamental understanding on the various applications of solar energy*

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	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11	PLO 12	PLO 13	PLO 14	PLO 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 about the present energy scenario and the potential of solar energy option for future energy demands*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	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	H	H	H	H	H	H	H	M	H	H	H	H
CLO-3:	*Gain a fundamental understanding of solar photovoltaics*	2	90	70	H	H	H	H	H	H	H	H	H	H	M	H	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	H	H	H	H	H	H	H	M	H	H	H	H
CLO-5:	*Differentiate between solar thermal and solar photovoltaic technologies and their applications*	2	90	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-6:	*Estimate the availability of solar radiation and efficiency of solar cell for any given conditions using the knowledge acquired*	2	75	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H

Duration (hour)		18	18	18	18	18
S-1	SLO-1	Introduction to energy scenario	Introduction to concentrating collectors	Solar thermal applications	Semiconductors as solar cell material	Solar module and array concepts
	SLO-2	The need for energy alternatives and the solar option	Definition of terms and types of concentrating collectors	Types of solar heating and cooling systems	Monocrystalline and polycrystalline materials	Series and parallel connection of cells
S-2	SLO-1	Solar radiation outside the earth's atmosphere	Compound parabolic collector	Natural circulation water heating system	Formation of energy bands and band gap	Mismatch in series connection
	SLO-2	Solar spectrum and solar constant	Geometry	Forced circulation water heating system	Concept of direct and indirect band gap	Mismatch in parallel connection
S-3	SLO-1	Solar radiation at earth's atmosphere, radiation spectrum and the concept of air mass	Tracking requirements	Concept of solar space heating	Charge carriers in semiconductors	Design and structure of solar modules
	SLO-2	The Sun-Earth movement, declination angle, and apparent motion of the Sun	Calculation of solar swing	Space heating systems using active methods	Carrier concentration and distribution	Basic concepts and fabrication process
S-4	SLO-1	Solar radiation geometry	Performance analysis	Passive heating concepts	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	Thermal storage wall, attached green house and sunspace	Qualitative understanding of carrier generation and recombination	Effect of temperature
S-5	SLO-1	Problem solving	Problem solving	Case study	Problem solving: Energy to wavelength conversion	Problem solving
	SLO-2	Calculation of declination angle, local apparent time, hour angle, and angle of incidence on a solar collector	Performance analysis of compound parabolic collector	Solar thermal heating market: Present and future	Maximum possible wavelength a material would absorb based on band gap value	Series and parallel connecting of cells of different parameters
S-6	SLO-1	Problem solving	Case study	Case study	Problem solving	interpretation of knowledge to understand commercial module specifications
	SLO-2	Calculation of declination angle, local apparent time, hour angle, and angle of incidence on a solar collector	State-of-the art in CPC	Solar space heating technology: Practical applications and present market	Electron and hole concentrations in doped semiconductors	Terms and concepts
S-7	SLO-1	Empirical estimation of solar radiation on horizontal surface	Cylindrical parabolic collector	Introduction to space cooling and refrigeration	Introduction to pn junction	Introduction to balance of system (BoS)
	SLO-2	Monthly average daily global and diffuse radiation	Orientation and tracking modes	Solar absorption refrigeration system	Qualitative analysis of formation of pn junction under equilibration conditions	Need for batteries and converters
S-8	SLO-1	Empirical estimation of solar radiation on horizontal surface	Performance analysis	Passive cooling concepts	pn junction in non-equilibrium condition	Concept of maximum power point tracking
	SLO-2	Monthly average hourly global and diffuse radiation	Derivation of instantaneous collection efficiency	Ventilation and ground cooling concept	Biasing of a pn junction and the current-voltage equation of a pn junction diode	Methods in practice
S-9	SLO-1	Solar radiation on tilted surfaces	Paraboloid dish collector	Evaporative cooling	pn junction under illumination	Concepts in PV system design
	SLO-2	Empirical equation for direct, diffuse, reflected, and total radiation	General considerations	Basic principles and design concepts	Generation of photovoltage	Stand-alone PV system configurations
S-10	SLO-1	Measurement of solar radiation	Central receiver collector	Radiative cooling	Light generated current	Concept of Hybrid PV systems
	SLO-2	Operation principle of pyranometer and pyrheliometer	Heliostats and the receiver	Physical principles and radiative cooling systems	I-V equation of solar cells	Qualitative idea of Types and issues with hybrid systems
S-11	SLO-1	Problem solving	Problem solving	Case study	Tutorial: Mapping solar cell parameters in an I-V curve	Case Study
	SLO-2	Calculation of monthly average daily global radiation on horizontal surfaces at different locations	Estimation of instantaneous collection efficiency for given conditions	Solar space cooling technology: Practical applications and present market	Efficiency measurements	Performance analysis of stand-alone PV systems
S-12	SLO-1	Problem solving	Case study	Case study	Problem solving	Case study
	SLO-2	Calculation of solar flux on tilted surfaces	Present technology and future of concentrating collectors	Solar space cooling technology: Practical applications and present market	Estimation of upper limits of solar cell parameters	Performance analysis of hybrid PV systems
S-13	SLO-1	Solar thermal collection	Introduction to thermal energy storage	Solar thermal power plants	Basic silicon solar cell	Grid-connected PV systems
	SLO-2	Liquid flat-plate collector	Basic methods for storing thermal energy	Low temperature power generation systems	Structure and efficiency limits	System installation
S-14	SLO-1	Performance analysis of liquid flat-plate collector	Sensible heat storage	Medium temperature systems	Introduction to thin films solar cell technologies	Operation and maintenance of PV systems
	SLO-2	Transmissivity-absorptivity product and instantaneous collection efficiency	Types and properties of sensible heat storage materials	Power generation cycle using cylindrical parabolic concentrating collectors	Key material properties and efficiency limits	Practical issues
S-15	SLO-1	Overview of the effect of various parameters on performance	Latent heat storage	High temperature systems	Effect of band gap on efficiency	Concept of simple payback period
	SLO-2	Selective surfaces, spacing, number of cover, fluid temperature, and dust on the top cover	Phase change materials and latent heat storage arrangements	High temperature systems using paraboloid dish and central receiver concepts	Beyond single junction efficiency limit	Lifecycle costing

S-16	SLO-1	Alternatives to the conventional collector	Thermochemical storage	Solar distillation and desalination technology	Approaches to overcome single junction efficiency limit	Annualized LCC
	SLO-2	Evacuated tube collector designs	Thermochemical storage reactions	Solar drying and solar cooking	Efficiency measurements	Unit cost of generated electricity
S-17	SLO-1	Numerical examples	Case study: Analysis of a liquid storage tank	Tutorial	Case study: GaAs solar cell	Tutorial
	SLO-2	Calculation of instantaneous efficiency	Qualitative analysis	Solar thermal power plants: National and International status	Solar cell Lab Visit	Demonstration of Installation of solar panel at site visit inside the campus
S-18	SLO-1	Problem solving	Case study: Analysis of a liquid storage tank	Tutorial	Demonstration of measurement of Solar cell efficiency	Tutorial
	SLO-2	Calculation of transmissivity-absorptivity product	Well-mixed and thermal stratification conditions	Solar distillation and desalination: Industrial plants	Demonstration of measurement of Solar cell efficiency	Safety handling of PV systems

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 (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
Dr. DK Aswal, NPL, *dkaswal@nplindia.org*	Prof. V Subramanian, IIT Madras, manianvs@iitm.ac.in	Dr. S. Chandramohan, SRMIST
Dr. M Krishna Surendra, Saint Gobain Research, krishana.muvvala@saint-gobain.com	Prof. S Balakumar, University of Madras, balakumar@unom.ac.in	Dr. P. Malar, SRMIST

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Course Code	UPY20D03T	Course Name	Low temperature physics	Course Category	D	Discipline Specific Elective Course	L	T	P	C
							4	2	0	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:
CLR-1:	*Acquire knowledge of different cooling methods which are used both above and below one kelvin*
CLR-2:	*Understand the concepts and working principles of different thermometers*
CLR-3:	*Familiarize different physical properties of Helium 3 and 4*
CLR-4:	*Know materials properties at low temperatures*
CLR-5:	*Explore the concept of superconductivity and its applications*
CLR-6:	*Understand the concepts of heat capacity and spectral properties of materials at low temperatures*

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 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:	*Describe production of low temperatures.*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-2:	*Explain the functionality of different types thermometers*	2	80	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-3:	*Describe the phase diagrams for both helium-3 and helium-4*	2	75	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-4:	*Explain the basic properties of both high Tc and low Tc superconductors*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-5:	*Explain physical properties of different materials at low temperature.*	2	80	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-6:	*Account for the basic ideas of the BCS theory, like Cooper-pairing and energy gap*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H

Duration (hour)		18	18	18	18	18
S-1	SLO-1	Zeroth law of thermodynamics	Primary thermometers	Liquid Nitrogen properties	Theory of Bloch	Specific heats in solids
	SLO-2	First law of thermodynamics	Primary thermometers working principles	Liquification method	Theory of Bloch	basics

S-2	**SLO-1**	reversible processes	Secondary thermometers	Liquid oxygen properties	Superconductivity	Classical model of specific heat capacity
	SLO-2	Irreversible processes	working principles	Liquification method	Superconductivity	derivation
S-3	**SLO-1**	Second law of thermodynamics	The gas thermometer	Liquid hydrogen properties	Meissner effect	Einstein model of specific heat capacity
	SLO-2	Thermodynamic scale of temperature and Entropy	working principles and experiment	Liquification method	type I and type II superconductors	derivation
S-4	**SLO-1**	Joule Thomson effect	Vapor pressure thermometer	Liquid He-3 and -4 properties	Cooper-pair, energy gap	Debye's model of specific heat capacity
	SLO-2	Regenerative cooling	working principles and experiment	Liquification method	Cooper-pair, energy gap	derivation
S-5	**SLO-1**	Problem solving: Zeroth and 1st Law of thermodynamics	Problem solving: Thermometers	Problem solving: Liquid He 4	*Lab visit to visualize the low temperature superconductivity effects*	Problem solving: Classical model
	SLO-2	Problem solving: 2nd Law of thermodynamics	Problem solving: Thermometers	Problem solving: Liquid He 4	Problem solving: Meissner effect	Problem solving: Einstein model
S-6	**SLO-1**	Problem solving: Entropy	Problem solving: Calibration and corrections	Problem solving: Liquid He 3	Problem solving: Cooper-pair, energy gap	Problem solving: Einstein model
	SLO-2	Problem solving: Entropy	Problem solving: Calibration and corrections	Problem solving: Liquid He 3	Problem solving: Cooper-pair, energy gap	Problem solving: Debye's model
S-7	**SLO-1**	Vacuum pumps Low vacuum	Resistance thermometer	Solid He– 4 properties	magnetic properties of superconductors	Heat capacity curves of three models
	SLO-2	Vacuum pumps High vacuum	working principles and experiment	Solid He– 4 phase diagram	B-H, M-H curves	Comparison of classical, Einstein and Debye's model
S-8	**SLO-1**	Vacuum gauges Pirani gauge	Pt-resistance thermometers	Solid He– 3 properties: Density and compressibility	Thermal properties of superconductors	Schottky effect
	SLO-2	Vacuum gauges penning gauge	working principles and experiment	Solid He– 3 Phase diagram	Heat capacity and entropy curves	Schottky effect
S-9	**SLO-1**	Liquefaction of air and Hydrogen	Seebeck and Peltier effect	Lamda point, Density and compressibility of He-4	The London equations	Anomalies in specific heats at low temperature
	SLO-2	Liquefaction of air and Hydrogen Experimental explanation	working principles and experiment	Lamda point of He-3	Derivation	Anomalies in specific heats at low temperature
S-10	**SLO-1**	Liquefaction of Helium	Thermocouple thermometers	Superfluidity in He-4	penetration depth, Tunneling and high frequency resistance	Visible and Infrared spectra basics
	SLO-2	Liquefaction of Helium Experimental explanation	working principles and experiment	Superfluidity in He-3	Derivation	Infrared spectra at low temperatures
S-11	**SLO-1**	Problem solving: Vacuum conductance	Problem solving: Resistance thermometers	Problem solving: Density and compressibility	Problem solving: Magnetic properties of SC	Problem solving: Visible and Infrared spectra
	SLO-2	Problem solving: Flow regimes	*Lab visit to demonstrate the thermometer functionalities*	Problem solving: Density and compressibility	Problem solving: Magnetic properties of SC	Problem solving: Visible and Infrared spectra
S-12	**SLO-1**	*Lab visit to see the liquefaction of Nitrogen*	Problem solving:Seebeck and Peltier effect	Problem solving:Lamda point	Problem solving: penetration depth, Tunneling	Problem solving: Schottky effect
	SLO-2	Problem solving: Gauges	Problem solving:Seebeck and Peltier effect	Problem solving:Lamda point	Problem solving: penetration depth, Tunneling	Problem solving: Schottky effect
S-13	**SLO-1**	Adiabatic demagnetization	Dia, para and ferromagnetism basics	viscosity of He-4	Josephson effects	Dielectric constant and its measurement
	SLO-2	Experimental details	Dia, para and ferromagnetism materials	viscosity of He-3	Josephson effects	Experiments
S-14	**SLO-1**	Evaporative cooling of He-3	Dia, para and ferromagnetic Susceptibility	thermal properties of He-4	Superconductivity applications	Clausius-Mossotti equations
	SLO-2	Experimental details	Susceptibility at low temperatures	thermal properties of He-3	Superconductivity applications	Derivation
S-15	**SLO-1**	Dilution refrigeration	magnetic thermometers	Velocity of sound in liquid helium second sound	Diamagnetic theory	NMR at low temperature
	SLO-2	Experimental details	working principles and experiment	Velocity of sound in liquid helium second sound	derivation	electron paramagnetic resonance at low temperature
S-16	**SLO-1**	Laser cooling and Nuclear demagnetization	Callender bridge	refrigerating machines	Paramagnetism	Mossbauer effect
	SLO-2	Experimental details	working principles and experiment	working principles	Langevin function derivation	Mossbauer effect – different interactions
S-17	**SLO-1**	Problem solving: Adiabatic demagnetization	Problem solving: dia, para and ferromagnetism	Problem solving: viscosity	Problem solving: Diamagnetic theory	*Lab visit: Demonstration of Dielectric constant measurements*
	SLO-2	Problem solving: : Adiabatic demagnetization	Problem solving:dia, para and ferromagnetism	Problem solving: viscosity	Problem solving: Diamagnetic theory	Problem solving: Dielectric constant
S-18	**SLO-1**	Problem solving: Laser cooling	Problem solving: Susceptibility	Problem solving: Velocity of sound in liquid helium	Problem solving: Paramagnetism	Problem solving: Mossbauer effect
	SLO-2	Problem solving: Laser cooling	Problem solving:Susceptibility	Problem solving: Velocity of sound in liquid helium	Problem solving: Paramagnetism	Problem solving: Mossbauer effect

Learning Resources	1. Low Temperature Physics, Christian E. and Siegfried H, (Springer, 2005) 2. Progress in Low Temperature Physics, CornelisJacobusGorter, D. F. Brewer, (Elsevier Ltd, 2011)	3. Properties of Liquid and Solid Helium, John Wilks, (Oxford University Press, 1967). 4. Low Temperature Physics, Jackson L.C., (Methuen and Company,1962).

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, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. N Vijayan, NPL, nvijayan @nplindia.org	Prof. K. Sethupathi, IIT Madras, *ksethu@iitm.ac.in*	Dr. K. Kamala Bharathi, SRMIST
Dr. M Satish , CSIR-CECRI, msathish@cecri.re.in	Prof. R. Nirmala, IIT Madras, nirmala@iitm.ac.in	Dr. Mohamed Ameen, SRMIST

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Course Code	UJK20301T	Course Name	Universal Human Values	Course Category	JK	Life Skill Course	L	T	P	C
							2	0	0	2

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*To generate in students a sensitivity to current regional and national issues such as gender marginalization Eco sensitivity, vision for the Nation and general humanness*
CLR-2 :	*An expanded consciousness with a mind to accommodate all is developed*
CLR-3 :	*The ability to accept all and to co- exist is initiated*
CLR-4 :	To create community connectivity and interdependence
CLR-5 :	To instill intrinsic link between freedom and responsibility for both individuals and communities
CLR-6 :	Make them learn the basic nature of human beings

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 :	*Become sensitive toward every living life and be able to respect every religion recognizing the universal values*	2	75	60	H	H	H	H	-	-	-	H	H	H	H	H	-	-	-
CLO-2 :	*Every way of life and culture will kindle the curiosity in them to know them and will be able appreciate the beauty in it*	2	80	70	H	H	H	H	-	-	-	H	H	H	H	H	-	-	-
CLO-3 :	*The presumptuous or prejudiced mentality will be overcome by them*	2	70	65	H	H	H	H		-	-	-	-	-	-	-	-	-	-
CLO-4 :	*Critical thinking and accommodative nature will become so natural way of thinking for them*	2	70	70	H	H	H	H	H	-	-	-	-	-	H	-	-	-	-
CLO-5 :	*They will become aware of the social inequalities and justice*	2	80	70	H	H	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	*Will be able to explore their own emotions, hopes & fear and be able to describe them verbally*	2	75	70	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H

Duration (hour)		06	06	06	06	06
S-1	SLO-1	What is love? Forms of love. For self, parents, family, friends, spouse, community, nation, humanity and other beings, both for living and non living	*Love compassion empathy sympathy and non violence*	*Narratives and anecdotes from history, literature including local folklore*	*What will learners lose if they don't practice love and compassion?*	*Sharing learners' individual and/ or group experiences*
	SLO-2	Love and Compassion inter relatedness	*Individuals who are remembered in history for practicing compassion and love*	*Practicing Love and Compassion: what will they gain if they practice compassion?*	*Simulated situations*	Case studies
S-2	SLO-1	*Whatis Truth ?*	*Universal truth, truth as value, as fact,*	*Veracity, sincerity, honesty among others*	Individuals who are remembered in the history who have practiced these values	Practicing truths
	SLO-2	*: what will they gain if they practice truth*	*What will learners lose if they don't practice truth?*	*Sharing learners' individual and/ or group experiences*	*Simulated situations*	Case studies

S-3	**SLO-1**	*What is non violence – its need, love compassion,*	*empathy sympathy for others as pre-requisites for non- violence*	**Ahimsa as non violence and non killing**	*Individuals and their organizations which are known for their commitment for non violence*	Narratives and anecdotes about non violence from history and literature including local folklore
	SLO-2	Practicing non violence	*What will they gain if they practice non violence*	*What will learners lose if they don't practicenon violence?*	*Simulated situations*	Case studies
S-4	**SLO-1**	*Whatisrighteousness ?*	*Righteousness and Dharma*	*Righteousness and priority*	Individuals who are remembered in the history who have practicing righteousness.	Narratives and anecdotes about Righteousness from history and literature including local folklore
	SLO-2	Practicing *Righteousness*	*: Sharing learners' individual and/ or group experiences*	*what will learners lose if they don't practiceRighteousness*	*Simulated situations*	Case studies
S-5	**SLO-1**	*What is peace?*	*Need of peace in Relation with harmony and balance*	Narratives and anecdotes about peace from history and literature including local folklore	Individuals who are remembered in the history who have practicing peace	Practicingpeace
	SLO-2	*What will they gain if they practice peace*	*what will learners lose if they don't practice peace*	*Sharing learners' individual and/ or group experiences*	*Simulated situations*	Case studies
S-6	**SLO-1**	What is service and renunciation	*Forms of service ,& renunciation Individuals who have recommended service in history*	*Practicing service and renunciation*	Narratives and anecdotes about Service & renunciation from history and literature including local folklore	Individuals who are remembered in the history who have practicing renunciation
	SLO-2	*Sharing learners' individual and/ or group experiences on renunciation*	*Sharing learners' individual and/ or group experiences on service*	*what will learners lose or gain if they do/don't practiceRenunciation and service*	*Simulated situations*	Case studies

Learning Resources	***Theory:*** 1. "Universal Human Values:Text Book"– Compiled and Edited by the Faculty of Science and Humanites, SRMIST, 2020.

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 Understand	40%	-	40%	-	40%	-	40%	-
Level 2	Apply Analyze	40%	-	40%	-	40%	-	40%	-
Level 3	Evaluate Create	20%	-	20%	-	20%	-	20%	-
	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
	1. Prof. Daniel David, Prof & Head, Department of English, MCC, Chennai	*1. Dr. Shanthichitra, Associate Professor, & Head, Department of English, FSH,SRMIST*
		2. Dr K B Geetha, Assistant Professor, Department of English, FSH, SRMIST

UNIVERSAL HUMAN VALUES (UJK20301T**)**

FACULTY OF SCIENCE AND HUMANITIES, SRMIST

SEMESTER III

SYLLABUS

This course aims at making learners conscious about universal human values in an integral manner, without ignoring other aspects that are needed for learner's personality development.

Objectives:

The present course deals with meaning, purpose and relevance of universal human values and how to inculcate and practice them consciously to be a good human being and realize one's potentials.

Learning Outcomes:

By the end of the course the learners will be able to:

1. Know about universal human values and understand the importance of values in individual, social circles, career path and national life.
2. Learn from case studies of lives of great and successful people who followed and practiced human values and achieved self- actualization.
3. Become conscious practitioners of human values.
4. Realise their potential as human beings and conduct themselves properly in the ways of the world.

Credit: 02

UNIT I

LOVE & COMPASSION

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

TRUTH

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

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

UNIT II

NON- VIOLENCE

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

RIGHTEIUSNESS

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

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

UNIT III

PEACE

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

SERVICE

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

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

UNIT IV

RENUNCIATION

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

GRATITUDE

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

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

UNIT V

SCREENING OF MOVIES - THE WATER BY DEEPA MEHTA

THE TWO POPES BY FERNANDO MEIRELLES

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

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SEMSTER IV

Course Code	UPY20401J	Course Name	Solid State Physics	Course Category	C	Core Course	L	T	P	C
							4	0	4	6

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	*Understand the formation of solids*
CLR-2:	*Acquire basic knowledge of crystal systems and spatial symmetries*
CLR-3:	*Explore structure-property relationship*
CLR-4:	*Classification of solids based on their properties*
CLR-5:	*Introducing quantum principles in solids*
CLR-6:	*Applications of materials used in day-to-day life*

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:	*A brief idea about crystalline and amorphous substances, about lattice, unit cell, miller indices, reciprocal lattice, concept of Brillouin zones and diffraction of X-rays by crystalline materials.*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-2:	*Understanding above the band theory of solids and must be able to differentiate insulators, conductors and semiconductors.*	2	80	70	H	H	H	H	M	H	H	H	M	H	M	H	H	H	H
CLO-3:	*knowledge of different types of magnetism from diamagnetism to ferromagnetism and hysteresis loops and energy loss.*	2	75	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-4:	*Knowledge of lattice vibrations, phonons and in depth of knowledge of Einstein and Debye theory of specific heat of solids.*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-5:	*Understand the basic idea about superconductors and their classifications*	2	80	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-6:	*Secured an understanding about the dielectric and ferroelectric properties of materials.*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H

Duration (hour)		24	24	24	24	24
S-1	SLO-1	Introduction to Solid State Physics	Introduction to Atomic Bonding Different types of bonding	Lattice vibrations	Drude-Lorentz theory for free electron	Introduction to Dielectrics
	SLO-2	Crystalline and Amorphous Solids	Potential Energy vs Interatomic distance	Dynamics of chain of identical atoms	Classical theory for Electrical conductivity of metals	Dipole Moment
S-2	SLO-1	Lattice with a Basis	Introduction to Bonding	Vibration of one dimensional monatomic linear lattice	Quantum Theory for electrical conductivity	Polarization
	SLO-2	Lattice Translational Vectors	Primary bonds	Derivation of force constant dispersion relation	Wiedemann and Franz law	Local electric field
S-3	SLO-1	Crystal Structures	Secondary Bonds	Brillouin Zone	Fermi energy	Displacement vector
	SLO-2	Lattice Parameters for Seven Crystal Systems	Properties of Primary and Secondary bonds	Phase velocity	Fermi-Dirac Distribution	Dielectric constant
S-4	SLO-1	Bravais lattice	Binding energy of solids	group velocity of lattice vibration	Density of states	Polarizability
	SLO-2	Unit Cell	Bond dissociation Energy of NaCl	Introduction to Phonons	Calculation for Density of States	Classification of Polarizability
S-5 to S-8	SLO-1	Basics of experimentation	To study the V-I characteristics of a light dependent resistors (LDR)	Repeat/revision of experiments	Determination of magnetic susceptibility of solids	Determination of resistance of semiconductor by Vander Pau's method
	SLO-2					
S-9	SLO-1	Symmetry elements	Introduction to Cohesive Energy	Characteristics of phonons Phonon momentum	Kronig-Penny model	Clausius-Mossotti Equation
	SLO-2	Problem solving- Bravais lattice	Cohesive Energy to Ionic crystals	Acoustic and Optical phonons	Features: Kronig-Penny model	Derivation of Clausius-Mossotti Equation
S-10	SLO-1	Diamond Structure	Madelung energy –	Qualitative description of phonon spectrum in solids	Band theory of solids	Introduction to superconductivity
	SLO-2	Hexagonal Closely Packed Structure	Evolution of Madelung constant.	Thermal Properties of Solids	Introduction to Band gap	Curie-Weiss Law
S-11	SLO-1	Atomic Packing fraction	Introduction to Magnetic materials	Classical theory of specific heat	Conductors, Semiconductors and Insulators	Occurrence of superconductivity
	SLO-2	Miller Indices	Classification of Magnetic materials	Dulong-Petit's Law	Semiconductors	Source of Superconductivity
S-12	SLO-1	Point groups	Dia and Paramagnetic materials	Einstein's theory of specific heat	Intrinsic semiconductors	Critical Temperature
	SLO-2	Space groups	Ferromagnetic materials	Einstein's theory of specific heat	Extrinsic semiconductors	Response of Magnetic Field
S-13 to S-16	SLO-1	Determination of lattice parameter using X-ray diffraction	Determination of Plank's constant using Light emitting diode.	Determination of dielectric constant of the different material	To trace the hysteresis loop for the magnetic material	Characteristic of Photo cell
	SLO-2					
S-17	SLO-1	Reciprocal Lattice	Magnetic moment	Debye approximation-specific heat capacity	Electrical resistivity of Metals	Meissner effect
	SLO-2	Comparison of Real and Reciprocal lattice	Classical Langevin Theory	Density of states of Phonons	Matthiessen's rule	Type I Superconductors
S-18	SLO-1	Brillion Zone	Ferromagnetic domains and Domain Walls	Debye model for Specific heat	Introduction to Hall Effect	Type II Superconductors
	SLO-2	Generation of X-rays	Ferromagnetic Domain Walls	Debye model for Specific heat	Hall Co-efficient	London's equation

S-19	**SLO-1**	Diffraction of X-rays by Crystals	Quantum Mechanical Treatment of Para magnetism	Experimental and theoretical predictions agree each other withT3 law.	Measurement of electrical conductivity	Penetration depth
	SLO-2	Bragg's Law	Curie's Law	Experimental verification of specific heat capacity	Two-probe Methods	Isotope effect
S-20	**SLO-1**	Atomic and Geometric factor	B-H curve and Hysteresis	Problem solving –Brillouin Zone	Four probe methods	Idea of BCS Theory
	SLO-2	Problem solving –Packing fraction	Problem solving –Madelung constant	Problem solving – Specific heat capacity	Problem solving – Wiedemann-Franz Law	Problem Solving – Dielectric Constant
S-21 to S-24	**SLO-1**	Determination of the resistivity of a given material using four probe method.	Determination of magnetic susceptibility for a given paramagnetic liquid by Quincke's method.	Determination of bandgap of a given material using post office box method.	Determination of Hall-coefficient and carrier type for a given semiconductor material.	repeat/revision of experiments
	SLO-2					

Learning Resources	1. Solid State Physics : Structure and Properties of Materials,M. A. Wahab,.(3rd edition, Narosa Publishing House). 2. Solid State Physics, S. O. Pillai,(6thedition,New AGE Science, 2013). 3. Introduction to Solid State Physics, Charles Kittel, (Wiley,2005).	4. Solid State Physics, Ashcroft Wanderman N.D., (Holt-Rinehart-Winston,1976). 5. Solid State Physics, Blakemore J.S., (2nd edition, Cambridge University, Press,1974). 6. Solid State Physics, Dekker A.J., (Mac Millan,1971)

Learning Assessment

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

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

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. N Vijayan, NPL, nvijayan @nplindia.org	Prof. C Venkateshwaran, University of Madras, venkateshwaran@unom.ac.in	Dr. Suresh Perumal, SRMIST
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Course Code	UPY20D04J	Course Name	Computational Physics	Course Category	D	Discipline Specific Elective Course	L	T	P	C
							4	0	4	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		
		1	2	3
CLR-1:	*Know the basics of errors in arithmetic operations and numerical methods*			
CLR-2:	*Understand basic programming techniques using MATLAB*			
CLR-3:	*Learn the array and matrix based numerical operations using MATLAB with examples*			
CLR-4:	*Understand the control flow of MATLAB*			
CLR-5:	*Know the essential plotting techniques using MATLAB*			
CLR-6:	*Realize the importance of MATLAB in solving physics problems*			

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 importance of errors in computations*	2	80	75
CLO-2:	*Able to write and execute MATLAB programs*	2	80	70
CLO-3:	*Make plots using MATLAB on scientific results*	2	75	70
CLO-4:	*Implement MATLAB for real life physics problems*	2	80	75
CLO-5:	*Master in MATLAB coding and programming*	2	80	70
CLO-6:	*Recognize the importance of MATLAB in modeling and simulations*	2	80	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	PSO - 1	PSO - 2	PSO - 3
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H

Duration (hour)		24	24	24	24	24
S-1	**SLO-1**	Definition of error	MATLAB - Introduction	M file – Creating and saving a script file	MATLAB plot module	Linear Interpolation
	SLO-2	Absolute error, Relative error	Creating variables	Running a simple script	Importing and exporting data	Spline and cubic interpolations

S-2	**SLO-1**	Precision and accuracy	Operator precedence	Global variables	Plotting graphs (plot, mesh and surf commands)	Numerical integration in one dimension using MATLAB commands
	SLO-2	Error in basic arithmetic operations	Data types	Input to a script	Plotting multiple data sets in single plot	Numerical integration in one dimension using MATLAB commands
S-3	**SLO-1**	Round off error	Display formats	Output commands – disp, fprintf	Formatting a plot - Handling axes, legends, labels, title, scale colors other graph properties	Discrete Fourier Transform
	SLO-2	Truncation error	Workspace management	Relational and logical operators	Formatting a plot - Handling axes, legends, labels, title, scale colors other graph properties	Discrete Fourier Transform
S-4	**SLO-1**	Error propagation in arithmetic operations	Managing MAT files	Conditional statements – if else structure	Plotting in linear scale	Fast Fourier Transform –
	SLO-2	Error propagation in arithmetic operations	Using MATLAB help	If-else-end structure	Plotting in log scale	Inverse Fast Fourier Transform
S-5 to S-8	**SLO-1**	MATLAB workspace familiarization	Programming using arrays and matrix operations	Revision/Repeat class	Plot of Depletion capacitance of a pn junction using MATLAB and Break down voltage vis impurity concentration for a one-side step junction for Si and Ge with varying doping concentration	Determination of electron (μn) and hole (μp) mobilities versus doping concentration in semiconductor using MATLAB
	SLO-2					
S-9	**SLO-1**	Error propagation in iterated algorithms	Arrays and matrices	If-elseif-else-end statement	Plots with special graphics	Motion in one dimension –
	SLO-2	Error propagation in iterated algorithms	Matrix indexing, Matrix dimensions - Colon operator	Switch case statement	Histograms	Motion in one dimension
S-10	**SLO-1**	Methods for reducing error	Adding and deleting rows and columns in matrix	Loops – For loop	Polar plots	Motion of free-falling object –
	SLO-2	Methods for reducing error	Saving and restoring matrix	While loop	Exporting plots in different format	Motion of free-falling object
S-11	**SLO-1**	Solving linear equation systems	Sub matrix	Nesting of loops	Physical example	Falling of a body in a viscous medium –
	SLO-2	Numerical methods for linear systems	Functions to generate elementary matrices	Nested conditional statements	Curve fitting with polynomial	Falling of a body in a viscous medium –
S-12	**SLO-1**	Direct method for linear systems -Cramer's rule	Matrix arithmetic operations	Break and continue statements	Curve fitting with functions other than polynomial	Projectile motion (by Euler method)–
	SLO-2	Gauss elimination method	Matrix transpose and Inverse operation	Error checking	Basic fitting interface	Projectile motion (by Euler method)–
S-13 To S-16	**SLO-1**	Introduction to MATLAB built in functions and programming	Solving simultaneous linear equation using matrix method - Electrical resistive network analysis	Programming using conditional statement and loops for Flight of model rocket, and AC to DC converter	Fermi-Dirac distribution function for p and n-type semiconductor	Numerical solution of [2D] Poisson's and Laplace's equations: Examples using Dirchlet and Neumann boundary conditions
	SLO-2					
S-17	**SLO-1**	Iterative methods for solving linear equations – Jacobi iterative method	Vector operations	Functions in MATLAB	3D plots - Basics	Motion under an attractive Inverse Square
	SLO-2	Gauss seidal iterative method	Built-in functions for handling arrays	Inline functions	Line plots	Motion under an attractive Inverse Square
S-18	**SLO-1**	Convergence criteria	Solution of simultaneous linear equations using matrix method	User defined functions with examples	Mesh and surface plots	Fourier generation of a square wave
	SLO-2	Eigen values and Eigen vectors	Solution of simultaneous linear equations using matrix method	difference between script and user defined function	Mesh and surface plots	Fourier generation of a square wave
S-19	**SLO-1**	Successive over relaxation method	Strings and string variables	Debugging M files	Contour and Waterfall plots	Slider-Crank mechanism
	SLO-2	Conjugate gradient method	Matrix decomposition	Setting and handling break points	3D plots with special graphics	Slider-Crank mechanism
S-20	**SLO-1**	Errors in solving linear equations	Characteristic polynomials	Reading data from a file - writing data to a file	View command	A half cylinder rolling on a horizontal plane
	SLO-2	Iterative refinement	Exponentials of matrices	Feval command	Physical example	A half cylinder rolling on a horizontal plane
S-21 to S-24	**SLO-1**	Programming arithmetic operations and algebraic equations	Solving the time independent Schrodinger Equation> for bound states using a matrix method for finding the eigenvalues and eigenvectors of the energy operator	Determination of electron concentration versus temperature using MATLAB	Animation of the Slingshot Effect	Revision/Repeat class
	SLO-2					

Learning Resources	1. Numerical Methods with MATLAB, JH Methews and KD FinK, (3rdEdition, Prentice Hall, 1999). 2. Computational Physics, J.M. Thijssen(Cambridge University Press 2007). 3. Introduction to Numerical Analysis using MATLAB, RizwannButt (Jones and Bartlett Publishers, 2008).	4. An introduction to programming and numerical methods in MATLAB, S.R. Otto and J.P Denier (Springer International Edition, 2005). 5. MATLAB: An Introduction with Applications, Glilat A. (Wiley Student Edition, 2009). 6. MATLAB: An Introduction with applications, Dukkipati (New Age International Publishers, 2011).

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
Dr.VSubramanian- CLRI, subbu@clri.res.in	Prof. K. Sethupathi, IIT Madras, *ksethu@iitm.ac.in*	Dr.V.J.Surya, SRMIST
Mr. R Seshadri, Titan Company Limited, seshadri@titan.co.in	Dr. Ranjit Kumar Nanda, IIT Madras, nandab@iitm.ac.in	Dr. SaurabhGhosh, SRMIST

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Course Code	UPY20D05J	Course Name	Elements of Nanoscience and Nanotechnology	Course Category	D	Discipline Specific Elective Course	L	T	P	C
							4	0	4	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:
CLR-1:	*Acquire knowledge on dimensionality and size dependent properties*
CLR-2:	*Gain knowledge 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*
CLR-6:	*Understand the suitable preparation method required for different applications*

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning: Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1:	*Explain the size dependent behavior of nanomaterials*	2	80	75
CLO-2:	*Analyze the given nanomaterial and its properties*	2	80	70
CLO-3:	*Utilize the suitable material for a particular application*	2	75	70
CLO-4:	*Implement a suitable technique to study the nanomaterial*	2	80	75
CLO-5:	*Explain the methods involved for the preparation of nanomaterials*	2	80	70
CLO-6:	*Describe nanomaterial characterization techniques, advantageous and limitations*	2	80	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	PSO - 1	PSO - 2	PSO - 3
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	H	H	H	H	H

Duration (hour)		24	24	24	24	24
S-1	SLO-1	Definition of Nanoscience and Nanotechnology	Classification based on dimensionality	Fabrication of Nanomaterials Classification: Top-down approach	X-ray Diffraction (XRD)	Solar energy conversion
	SLO-2	Nanotechnology time line	Quantum Dots, Wells and Wires	Bottom-up approach	Peak Broadening method for crystallite size estimation	catalysis
S-2	SLO-1	Dimensionality	Carbon-based nanomaterials: Structure of graphite and Structure of Fullerene	Metal nanocrystals by Reduction	UV –Vis Spectroscopy (UV-Vis)	Nanoelectronics
	SLO-2	surface area to volume ratio of bulk materials and nanomaterials	Buckyballs	Sol-gel	Optical absorption Characteristics of nanomaterial	Molecular electronics
S-3	SLO-1	Chemical Properties of Nanoparticles: Surface Energy	Carbon nanotubes	Hydrothermal synthesis	Infrared spectroscopy	Micro-electromechanical systems (MEMS)
	SLO-2	Nanoparticles interacting with living systems	Types and Structure of carbon nanotubes	Solvothermal Synthesis	Functional Group analysis	Nano-electromechanical systems (NEMS)
S-4	SLO-1	Melting points and lattice constants of nanoparticles	Properties of CNT: Mechanical	Sonochemical Routes	Basic principles of Scanning Probe Microscopy–Overview	Memory devices
	SLO-2	Mechanical Properties of Nanostructured Materials	CNT-Electrical Properties	Photochemical Synthesis	Scanning Tunneling Microscopy (STM)	Nanomaterials for data storage
	SLO-1	Introducing Laboratory Protocol and Familiarizing with different	Synthesis of Silver nanoparticle by wet chemical reduction method		Characterization of ZnO nanomaterial using XRD	TEM analysis of nanomaterial

S-5 to S-8	**SLO-2**	experimental set-up to be used for the course		UV-Vis characterization of metal oxide nanoparticle and estimation of band gap energy.		
S-9	**SLO-1**	Classification of magnetic materials	Metal based nanomaterials: Nanogold and properties	Chemical Vapor Deposition (CVD)	STM studies on metals	Nanostructured Materials for Magnetic Recording
	SLO-2	Magnetization curve of ferromagnetic material	Nanosilverand properties	Molecular Chemical Vapor Deposition (MOCVD)	STM studies on semiconductors	Media and Recording heads
S-10	**SLO-1**	Super-paramagnetism	Metal oxide Nanomaterials	Molecular Beam Epitaxy (MBE): Fundamentals and working	Atomic Force Microscopy (AFM)-Modes	Liquid crystalline systems
	SLO-2	Magnetic Behavior of Nanoparticles	Nanoglass	Applications in Specialized semiconductor devices	SPM Advanced methods	Applications in displays and other devices
S-11	**SLO-1**	Electronic structure: Band Structure	Nanocomposites: Polymer nanocomposites	Sputtering technique: Principle and instrumentation	Nanoindentation: Fundamentals	Photonics
	SLO-2	Density of States (DOS) in bands	Metal oxide nanocoposites	Nanostructures and Nanocomposite thin films preparation	Characterization mechanical property of nanomaterials	Plasmonics
S-12	**SLO-1**	Variation of DOS at nanoscale	Polymer-CNT nanocomposites	Photolithography	Electron Microscopy: Electron–matter interaction	Food Industry
	SLO-2	Variation of band gap with size	Properties of Polymer-CNT nanocomposites	Lithographic process	Scanning Electron Microscope (SEM)	Agriculture Industry
S-13 to S-16	**SLO-1**	Observation of Bulk and Nanosized materials with SEM	Absorption spectroscopy of Silver Nanoparticles	Demonstration of thin film deposition by sputtering	Demonstration of AFM and image analysis of nanostructures	Analyses of given Raman spectra of nanomaterials
	SLO-2					
S-17	**SLO-1**	Quantum size effect	Polymers: Properties	Electron beam lithography: Instrumentation	Transmission Electron Microscope (TEM)	Chemical sensors
	SLO-2	Characteristic lengths	Co-Polymers	Patterning process	High Resolution TEM	Nanobiosensors
S-18	**SLO-1**	Electrical transport properties: Diffusive and ballistic regime	Bulk nanostructured materials	Focused Ion Beams (FIB) technique	Raman spectroscopy	Nanobiotechnology
	SLO-2	Single electron tunneling	Mechanical and electrical Properties	Nanostructures Using FIB	Surface enhanced Raman spectroscopy (SERS)	Nanomedicine
S-19	**SLO-1**	Optical Properties of bulk materials	Biological materials	Ball Milling	X-ray photoelectron spectroscopy (XPS)	Nanobots
	SLO-2	Interaction of light with semiconductor nanoparticles	Biological building blocks	Electrodeposition	Auger electron spectroscopy (AES)	Future prospectus
S-20	**SLO-1**	Interaction of light with metal nanoparticles	Biological Nanostructures: Proteins	Green synthesis	Principle importance of thermal analysis for nanostructures Thermo Gravimetric Analysis	Risks of Nanotechnologies
	SLO-2	Surface plasmon resonance	Multilayer films	Nanoparticles using plant extracts	Differential scanning calorimetry	Harnessing Nanotechnology for social development
S-21 to S-24	**SLO-1**	Characterization of surface morphology of bulk and Nanosized materials using given SEM images	Synthesis of metal oxide nanoparticle by sol-gel method	Demonstration of preparation ofNanomaterial using Ball Milling technique	Demonstration of TGA and analysis of thermal stability of a given weight loss data	Repeat/Revision of the experiments
	SLO-2					

Learning Resources	1. A Textbook of Nanoscience and Nanotechnology Pradeep T., (Tata McGraw Hill Education Pvt. Ltd., 2012). 2. Nanostructured Materials and Nanotechnology, Hari Singh Nalwa, (Academic Press, 2002). 3. Introduction to Nanotechnology, Charles P. Poole & Frank J. Owens, (John Wiley & Sons, Inc. 2003).	4. Organic and Inorganic Nanostructures,Nabok A., (Artech House, 2005). 5. Nanomaterials: Synthesis, Properties and Applications, A. S. Edelstein and R. C. Cammarata, (Institute of Physics Pub., 2001) 6. Textbook of Nanoscience and Nanotechnology, B.S. Murty, ShankarBaldev Raj, B Rath James Murday, (Springer, Universities Press (India) Private Limited 2013)

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

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

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. M Krishna Surendra, Saint Gobain Research, krishana.muvvala@saint-gobain.com	Prof. S Balakumar, University of Madras, balakumar@unom.ac.in	Dr. A. Karthigeyan, SRMIST
Mr. Navneethakrishanan, CLR Laboratories Pvt Ltd.	Prof. C Venkateshwaran, University of Madras, venkateshwaran@unom.ac.in	Dr. Eswaraiah, SRMIST

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Course Code	UPY20D06J	Course Name	Semiconductor Device Physics	Course Category	D	Discipline Specific Elective Course	L	T	P	C
							4	0	4	6

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Department of 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:	*Outline the classification of solids as metals, semiconductors, and insulators and distinguish direct and indirect semiconductors*			
CLR-2:	*Elucidate the importance of Quantum theory and its related principle*			
CLR-3:	*Know the physics of semiconductor junctions, metal– semiconductor junctions*			
CLR-4:	*Know the metal–insulator–semiconductor junctions and related device operations*			
CLR-5:	*Understand the principles of operation of new and future electronic devices*			
CLR-6:	*Acquire knowledge about the concepts of photonic devices based on semiconductors*			
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			
CLO-1:	*Describe structural properties of semiconductors*	2	80	75
CLO-2:	*Describe and infer quantum theory of solids*	2	80	70
CLO-3:	*Illustrate device building blocks*	2	75	70
CLO-4:	*Demonstrate the operation transistors and power devices*	2	80	75
CLO-5:	*Interpret optical devices*	2	80	70
CLO-6:	*Analyze semiconductor electrical properties*	2	80	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	PSO - 1	PSO - 2	PSO - 3
H	H	H	H	H	H	H	H	H	M	H	M	H	H	H
H	M	H	H	M	H	H	H	M	H	M	H	M	M	M
H	H	H	H	H	H	H	M	H	H	H	H	H	H	H
M	H	H	M	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	M	H	H	M	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H

Duration (hour)		24	24	24	24	24
S-1	SLO-1	Classification of materials: metal, semiconductor, insulator	Introduction to quantum physics	Intrinsic semiconductor	Various types of solid-solid junctions	Concept of transistor
	SLO-2	Bonding in solids	Principles of quantum mechanics	Energy bands in semiconductor	Contact potential and band bending	Classification of transistors: current and voltage controlled
S-2	SLO-1	Types of solids: crystalline, polycrystalline, amorphous	Particle like properties	Electrons and holes: conduction	Metal-semiconductor junction: Ohmic	Junction field effect transistor: principle
	SLO-2	Types of crystal structures	Wave like properties	Electrons and holes: concentrations	Metal-semiconductor junction: Schottky	Junction field effect transistor: amplifier
S-3	SLO-1	Primitive cell	de–Broglie hypothesis	Extrinsic semiconductor	Ideal P-N junction	Metal Oxide Field Effect Transistor (MOSFET): principle
	SLO-2	Unit cell	The uncertainty principle	p-type and n-type doping	Open circuit condition	MOS capacitor
S-4	SLO-1	Crystal planes	Wave function and time independent Schrodinger's Wave equation	Energy levels in extrinsic semiconductor	Diode equation	Mode of MOSFET operation: depletion
	SLO-2	Miller Indices	The physical meaning of Schrodinger's Wave equation	Degenerate semiconductor	Forward bias	Mode of MOSFET operation: enhancement
S-5 to S-8	SLO-1 / SLO-2	Basics of Experimentation	Characteristics of a PNP Transistor in CE configuration	Repeat/Revision of Experiments	Characteristics of a NPN Transistor in CE configuration	Determination of efficiency of solar cell
S-9	SLO-1	Defects in solids	Particle in a box: Finite potential	Boltzmann statistics	Reverse bias	Enhancement mode MOSFET: operation
	SLO-2	Point defects	Electron energy levels in an atom	Fermi-Dirac statistics	Junction parameters: current on/off ratio, ideality factor, forward threshold voltage	Enhancement mode MOSFET: figure of merit parameters
S-10	SLO-1	Line defects	Quantum numbers	Optical absorption	Depletion layer: width	Output and Transfer characteristics
	SLO-2	Planar defects	Angular momentum	Electron-hole pair generation	Depletion layer: capacitance	Equivalent circuit of MOSFET
S-11	SLO-1	Electrical conduction in solids	Linear combination of atomic orbitals	Direct band gap	Avalanche breakdown	Semiconductor laser: working principle
	SLO-2	Drude model	Lennard-Jones potential	Indirect band gap	Zener diode	Semiconductor laser: emission spectra
S-12	SLO-1	Temperature dependence of conductivity: metals	Band theory of solids	Conductivity and mobility	Principle of light emitting diode (LED)	Metal-Semiconductor FET (MESFET): working principle
	SLO-2	Temperature dependence of conductivity: semiconductors	Energy band formation in silicon	Drift velocity of charge carriers	LED output spectrum	MESFET characteristics
S-13 to S-16	SLO-1 / SLO-2	P-N Junction diode V-I Characteristics	Zener diode as a voltage regulator	Construction of Basic Logic gates-Diodes and Transistors	Construction of Basic Logic gates-Integrated Circuits	To study the Characteristics of FET
S-17	SLO-1	Matthiessen's rule	Properties of electrons in a band	Photoconductivity	LED: materials	High-electron mobility transistor (HEMT)
	SLO-2	Coefficient of resistivity	Band bending in presence of electric field	Majority and minority charge carriers	LED: brightness and efficiency	HEMT: materials
S-18	SLO-1	Thermal conductivity	Effective mass of electron	Hall effect: principle	Solar cell: working principle	Logic gates
	SLO-2	Thermal resistance	Density of states	Hall effect: semiconductors	Solar cell: parameters	Types of gates

S-19	SLO-1	Problem Solving: Miller indices	Problem Solving: de Broglie/Uncertainty Principle	Problem Solving: Hall effect	Problem Solving: LED	Problem Solving: MOSFET
	SLO-2	Problem Solving: Properties of materials	Problem Solving: Effective mass	Problem Solving: Band Gap	Problem Solving: Transistor with Biasing	Problem Solving: Gates
S-20	SLO-1	Ionic crystal	Bloch theorem	Temperature dependence of carrier concentration	Seebeck effect	Diode-diode logic gates: NAND
	SLO-2	Ionic conductivity	E-K diagram	Temperature dependence of carrier mobility	Seebeck effect for semiconductors	Transistor-transistor logic gates: NAND
S-21 to S-24	SLO-1	Zener diode V-I characteristics	NAND as Universal gate	Determination of Hall coefficient and carrier type for a given semiconductor material	I-V Characteristics of solar cell	Repeat/Revision of Experiments
	SLO-2					

Learning Resources	1. Principles of Electronic Materials and Devices, S. O. Kasap, (4th Edition, McGraw–Hill Higher– Education 2018 2. Solid State Electronic Devices, B. G. Streetman and S. K. Banerjee, (7thed, Pearson 2016)	3. Physics of Semiconductors Devices, S. M. Sze, (3rd Edition, John Wiley,2007) 4. Semiconductor Physics and Devices – Basic Principles, Donald A. Neamen, (3rd edition, McGraw–Hill Higher– Education 2003).	

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember / 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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Course Code	UCY20A03J	Course Name	Allied Chemistry	Course Category	G	Generic Elective Course	L	T	P	C
							4	0	4	6

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	*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 :	*Make aware of the fuels, fertilizers and other detergents*
CLR-4 :	*Understand the basic principles of chemical kinetics*
CLR-5 :	*Study the concepts in electrochemistry*

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	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 :	*Gain knowledge on the basic fundamentals in organic chemistry.*	2	2	75	H	H	H	H	-	-	-	-	-	-	-	-	H	-	-
CLO-2 :	*Acquire knowledge about hydrocarbon and their reactions.*	2	2	80	-	-	H	-	H	-	-	-	-	-	-	-	H	-	-
CLO-3 :	*Promote the importance of silicon and metals.*	2	2	70	H	H	-	-		-	-	-	-	-	-	-	-	M	-
CLO-4 :	*Understand the facts in chemical kinetics and photochemistry.*	2	2	70	H	H	-	H	H	H	-	-	-	-	-	-	H	M	-
CLO-5 :	*Understand the basic concepts in industrial chemistry*	2	2	80	H	-	H	-	H	-	-	-	-	-	-	-	H	-	-
CLO-6 :	*Acquire knowledge in the principles of electrochemistry*	2	2	75	H	-	-	-	-	-	-	-	-	-	-	-	H	M	-

Duration (hour)		24	24	24	24	24
S-1	SLO-1	Introduction of Hybridisation and Isomerism: Hybridisation - sp, sp^2 and sp^3	Chemical Kinetics:Rate of reaction	Gobar gas and natural gas	Chelation	Electrochemistry: Faradays laws of electrolysis
	SLO-2	Bond length- bond angle- dipole moment	order- molecularity		Industrial applications	
S-2	SLO-1	inductive effect- mesomeric effect and hyperconjucation	first order rate law and simple problems	Fertilizers –NPK and mixed	Industrial Chemistry: Hardness of water – Temporary and permanent hardness	Specific conductance, equivalent conductance
	SLO-2	Isomerism- geometrical and optical isomerism	Half-life period of first order reaction	soaps and detergents.	disadvantages of hard water	Cell constant

S-3	SLO-1	optical activity- asymmetry- dissymmetry	pseudo first order reaction	Carbohydrates, Benzene and Heterocyclic Compounds:Classification of carbohydrates	Boiler scales and sludges	Arrhenius theory of electrolytic dissociation
	SLO-2	elements of symmetry- R, S notations.	zero and second order reactions			Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity at infinite dilution
S-4 TO S-8	SLO-1	LAB INTRODUCTION	Estimation of FAS using standard oxalic acid	Estimation of Zn/Mg	Estimation of $K_2Cr_2O_7$ using decinormal solution of Sodium thiosulphatesolution	Determination of Molecular Weight of a Polymer
	SLO-2					
S-9	SLO-1	Hydrocarbons: Methods of preparation of alkanes	Arrhenius and collision theories	Properties and uses of glucose and fructose	Softening of hard water – Zeolite process	Ostwald"s dilution law
	SLO-2	Properties - Reactions		Mutarotation	demineralization process	Kohlrausch law of independent migration of ions
S-10	SLO-1	Free radical mechanism of halogention of alkanes	Arrhenius and collision theories	Chemistry of benzene	reverse osmosis	Nernst equation
	SLO-2	Methods of preparation of alkenes	Arrhenius and collision theories	Preparation	Purification of water for domestic use	Standard electrode (reduction) potential and its application to different kinds of half-cells.
S-11	SLO-1	Stereochemistry of dehydrohalogenation (E1, E2, E1CB mechanism)	Industrial Chemistry:Introduction-Fuel gases	Mechanism of electrophilic substitution reactions	use of Chlorine	
	SLO-2	Properties of alkenes, Electrophilic and nucleophilic addition mechanisms.		Mechanism of electrophilic substitution reactions	Ozone and UV light	
S-12 TO S-15	SLO-1	Estimation of NaOH using standard sodium carbonate	Estimation of FAS using standard potassium dichromate	Estimation of ascorbic acid	Estimation of Copper using decinormal solution of Potassium dichromate solution	Conductometric Titrations- II (KClvs $AgNO_3$)
	SLO-2					
S-16 TO S-20	SLO-1	Estimation of HCl using standard oxalic acid	Estimation of $KMnO_4$using standard potassium dichromate	Estimation of phenol / aniline	Estimation of Nickel using decinormal solution of EDTA	Potentiometric Titration (Redox Titrations)
	SLO-2					
S-21	SLO-1	Chemistry of Hydrogen, Silicon and Metals: Occurrence- extraction of iron- cobalt- nickel and copper	Water gas	Heterocyclic compounds– Preparation of pyrrole and pyridine.	Phase Rule and Adsorption: Phase rule- Definition of terms involved	Electromotive force of a cell and its measurement
	SLO-2			Properties of pyrrole and pyridine.		
S-22	SLO-1	chemical properties of iron- cobalt- nickel and copper		Coordination Chemistry:Nomenclature and isomerism of coordination compounds	phase diagram of H_2O	Nernst equation; Standard electrode (reduction) potential
	SLO-2				phase diagram of Pb-Ag	
S-23	SLO-1	atomic hydrogen and isotopes of hydrogen	producer gas	EAN rule	Adsorption - Langmuir adsorption isotherms	Nernst equation application to different kinds of half-cells
	SLO-2	Preparation and structure of borazole		VB Theory		
S-24	SLO-1	Preparation and structure of borazole	LPG gas	Crystal field theories of octahedral, tetrahedral and square planar complexes	Principles of chromatography (Paper, TLC and column).	Application of EMF measurements in determining (i) free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants
	SLO-2	SiO_2, SiC and $SiCl_4$				

Learning Resources	Theory 1. R. Gopalan, Text Book of Inorganic Chemistry, 2nd edition, Hyderabad, Universities Press, (India), 2012. 2. R.T. Morrison and R.N. Boyd, S. K. Bhattacharjee, Organic Chemistry, 7th edition, Pearson India, 2011. 3. B.R. Puri, L.R. Sharma and M.S. Pathania, Principles of Physical Chemistry, 35th edition, New Delhi ShobanLalNagin Chand and Co, 2013.	Practicals 1. V.Venkateswaran, R.Veeraswamy, A.R.Kulandaivelu, *Basic Principles of Practical Chemistry*, 2nd edition, Sultan Chand and Sons, 1997. 2. B.S. Furniss, A.J. Hannaford, P.W. G. Smith, A.R. Tatchell, *Vogel's Text Book of Practical Organic Chemistry*, 5th edition, Pearson Education, 2005.

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*20%*	*20%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	Understand										
Level 2	Apply	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*
	Analyze										
Level 3	Evaluate	*10%*	*10%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	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. ShanmukhaprasadGopi, Dr. Reddy' s Laboratories, shanmukhaprasadg@drreddys.com	Prof. Vivek Polshettiwar, TIFR Mumbai, vivekpol@tifr.res.in	Dr. T.Pushpa Malini, SRMIST

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Course Code	UPY20S03L	Course Name	Electronic Instrumentation	Course Category	S	Skill Enhancement Course	L	T	P	C
							0	0	4	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:	*Familiarize with measuring instruments used in Electronics Laboratory*	
CLR-2:	*Learning ways of measuring unknown Resistance, Capacitance and Frequency*	
CLR-3:	*Applications of diode in wave shaping circuits*	
CLR-4:	*Measurement of physical parameters through electronic transducers*	
CLR-5:	*Learn to understand and use various types of Analog instruments.*	
CLR-6:	*Develop knowledge of making measurements with Impedance Bridges*	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	1 Level of Thinking (Bloom)	2 Expected Proficiency (%)	3 Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1 Fundamental Knowledge	2 Application of Concepts	3 Link with Related Disciplines	4 Procedural Knowledge	5 Skills in Specialization	6 Ability to Utilize Knowledge	7 Skills in Modeling	8 Analyze, Interpret Data	9 Investigative Skills	10 Problem Solving Skills	11 Communication Skills	12 Analytical Skills	13 PSO - 1	14 PSO - 2	15 PSO - 3
CLO-1:	*Understand the usage of ammeter, voltmeter and galvanometer*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-2 :	*Impart the knowledge on measurement of resistance, capacitance and frequency*	2	80	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-3 :	*Understand the measurement of physical parameters such as strain, light intensity and temperature*	2	75	70	H	H	H	H	H	H	H	H	M	H	M	H	H	H	H
CLO-4 :	*Develop measurement skills with Cathode Ray Oscilloscope (CRO)*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-5 :	*Acquire hands on skills in the usage of multimeters, rectifiers, amplifiers, oscillators etc.*	2	80	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-6 :	*Gain skills on the working and operations of Impedance Bridges*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H

DURATION (HOURS)		12	12	12	12	12
S1 to S4	SLO-1	Design of Multi Range Ammeter and Voltmeter using Galvanometer	Measurement of Low Resistance by Kelvin's Double Bridge.	Study the characteristics of Light Dependent Resistor (LDR), Photodiode, and Phototransistor	Determine output characteristics of a Linear Variable Differential Transformer (LVDT) & measure displacement using LVDT	Determine the characteristics of Thermistors
	SLO-2					
S5 to S8	SLO-1	Measurement of Resistance by Wheatstone's Bridge and measurement of bridge sensitivity	Design and study of Sample and Hold circuit.	Study the generation of Lissajous figures to find unknown frequency and phase shift	Measurement of Strain using Strain Gauge.	Measurement of Temperature by Thermocouples and Study of Transducers like PT-100, J- type, K-type
	SLO-2					
S9 to S12	SLO-1	Measurement of Capacitance by De'Sauty's Bridge.	Design and analyze the Clippers and Clampers circuits using junction diode	Frequency measurement using Wein's Bridge	Determine the characteristics of Resistance Temperature Detector (RTD)	Repeat/Revision of experiment
	SLO-2					

Learning Resources	
	1. Electronic circuits: Handbook of design and applications, U. Tietze and C. Schenk (Springer, 2008)
	2. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller (Mc-Graw Hill, 1990)
	3. Electronic Instrumentation, Kalsi (Tata McGraw Hill, 2004)
	4. Modern Electronic Instrumentation and Measurement Techniques, Helfrick and Cooper (Pearson, 1992).
	5. Instrumentation Measurement and Analysis, Nakra and Chaudry (Tata McGraw Hill, 2003)
	6. Electronic Measurements and Instrumentation, Oliver and Cage (Tata McGraw Hill, 2009).
	7. Measurement and Instrumentation Principles, Morris (Elsevier (Buterworth-Heinmann), 2001).
	8. A Course in Electrical and Electronics Measurements and Instrumentation, Sawhney A. K. (Dhanpat Rai, 2015).
	9. Instrumentation Devices and Systems, Rangan, Sarma and Mani (Tata McGraw Hill, 1997).
	10. Introduction to Measurements and Instrumentation, Arun K. Ghosh (PHI, 2012).

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
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Course Code	UPY20S04L	Course Name	Workshop Practice	Course Category	S	Skill Enhancement Course	L	T	P	C
							0	0	4	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 :	*Use mechanical tools to make simple measurement of length, height, time, areaand volume.*
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*
CLR-6 :	*Mechanical skills needed for workshop experience*

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 :	*Familiarize with the basics of tools and equipment used in fitting, carpentry, sheet metal, welding and smithy*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-2 :	*Familiarize with the production of simple models in the above trades*	2	80	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-3 :	*Have hands on experience of the instruments in workshop*	2	75	70	H	H	H	H	H	H	H	H	M	H	M	H	H	H	H
CLO-4 :	*Understand the principle behind the working of various equipment*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-5 :	*Acquire mechanical skills in the basic workshops*	2	80	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-6 :	*Develop a skill in dignity of labour, precision, safety at work place, team working and development of right attitude.*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H

DURATION (HOURS)		12	12	12	12	12
S1 to S4	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					
S5 to S8	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					
S9 to S12	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 / 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	UMI20S01L	Course Name	My India project	Course Category	S	Skill Enhancement Course	L	T	P	C
							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*							

Assessment Method – Fully Internal

Learning AssessmentComponents	Marks
Review – I (Activities)	50
Review – II (Project report and Presentation)	50
Total	100

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Course Code	UJK20401T	Course Name	Professional Skills	Course Category	JK	Life Skill Course	L	T	P	C
							2	0	0	2
Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*					
Course Offering Department	*Career Development Centre*	Data Book / Codes/Standards	-							

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

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			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 :	*understand the importance of resume preparation and build resume*	*3*	*80*	*70*	*M*	*M*	*L*	*L*	*M*	*H*	-	-	-	*M*	*H*	*L*	*H*	*H*	*H*
CLO-2 :	*acquire group discussion skills*	*3*	*85*	*75*	*M*	*M*	*L*	*L*	*M*	*H*	-	-	-	*M*	*H*	*L*	*H*	*H*	*H*
CLO-3 :	*face interviews confidently*	*3*	*85*	*80*	*M*	*M*	*L*	*L*	*M*	*H*	-	-	-	*M*	*H*	*L*	*H*	*H*	*H*
CLO-4 :	*Ask appropriate questions during an interview*	*3*	*85*	*80*	*M*	*M*	*L*	*L*	*M*	*H*	-	-	-	*M*	*H*	*L*	*H*	*H*	*H*
CLO-5 :	*understand various types of presentation and use presentation skills in projects*	*3*	*85*	*80*	*M*	*M*	*L*	*L*	*M*	*H*	-	-	-	*M*	*H*	*L*	*H*	*H*	*H*
CLO-6 :	*build confidence during any presentation*	*3*	*85*	*80*	*M*	*M*	*L*	*L*	*M*	*H*	-	-	-	*M*	*H*	*L*	*H*	*H*	*H*

Duration (hour)		6	6	6	6	6
S-1	SLO-1	*Introduction of resume and its importance*	*Meaning and methods of group discussion*	*Meaning and types of interview (face to face, telephonic, video)*	*Types - Informative, Instructional, Arousing, Persuasive, Decision-making*	*PowerPoint presentation–body language and stage etiquettes*
	SLO-2	*Difference between a CV, Resume and Bio Data*	*Procedure of group discussion*	*Dress code, background research*	*Structure of a presentation – Introduction of the event, Introducing the speaker, vote of thanks*	*PowerPoint presentation–body language and stage etiquettes*

S-2	SLO-1	*Essential components of a good resume, common errors people make while preparing a resume*	*Group discussion – simulation*	*STAR Technique (situation, task, approach and response) for facing an interview*	*Working with audience – ice-breaking, Creating a 'Plan B',*	*PowerPoint presentation–practice session*
	SLO-2	*Resume building format*	*Group discussion – common errors*	*Interview procedure (opening, listening skills, closure, asking questions)*	*Getting the audience in the mood, working with emotions,*	*PowerPoint presentation– practice session*
S-3	SLO-1	*Resume building using templates*	*Group discussion – types – Topic based*	*Important questions generally asked in an interview*	*Improvisation and unprepared presentations, man-woman view, feedback – appreciation and critique*	*PowerPoint presentation–practice session*
	SLO-2	*Resume building using templates*	*Group discussion – types – Case study based*	*Important questions generally asked in an interview*	*Improvisation and unprepared presentations, man-woman view, feedback – appreciation and critique*	*PowerPoint presentation– practice session*
S-4	SLO-1	*Resume building activity*	*Group discussion – practice session- Topic based*	*Mock interview – face to face*	*Power point presentation, skit, drama, dance, mime, short films and documentary – Dos and Don'ts*	*PowerPoint presentation–practice session*
	SLO-2	*Resume building activity - Feedback*	*Group discussion - Feedback*	*Mock interview- Feedback*	*Power point presentation, skit, drama, dance, mime, short films and documentary – Dos and Don'ts*	*PowerPoint presentation– practice session*
S-5	SLO-1	*Video resume – Tips and tricks*	*Group discussion – practice session- Topic based*	*Mock interview - face to face*	*PowerPoint presentation – content preparation*	*PowerPoint presentation–practice session*
	SLO-2	*Video resume – Do's and Don'ts*	*Group discussion - Feedback*	*Mock interview - Feedback*	*PowerPoint presentation–logical arrangement of content*	*PowerPoint presentation– practice session*
S-6	SLO-1	*Video resume – Templates*	*Group discussion – practice session- Case study based*	*Mock interview - face to face*	*PowerPoint presentation–using internet source, citations, bibliography*	*PowerPoint presentation–practice session*
	SLO-2	*Video resume – Templates*	*Group discussion - Feedback*	*Mock interview- Feedback*	*PowerPoint presentation–using internet source, citations, bibliography*	*PowerPoint presentation– practice session*

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

Learning Assessment

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%	15%
	Understand				
Level 2	Apply	50%	50%	40%	50%
	Analyze				
Level 3	Evaluate	40%	40%	30%	35%
	Create				
	Total	**100 %**	**100 %**	**100 %**	**100 %**

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

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

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. Ajay Zener, Director, Career Launcher	-	*1. Mr Priyanand, Assistant Professor, CDC, E&T, SRMIST*
		2. Ms Sindhu Thomas, Head in charge, CDC, FSH, SRMIST
		3. Ms Mahalakshmi, Assistant Professor, CDC, FSH, SRMIST

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SEMESTER V

Course Code	UPY20501J	Course Name	Modern Optics	Course Category	C	Core Course	L	T	P	C
							4	0	4	6

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	*Acquire knowledge of basic optics*
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:	*Explore the concept of Laser*
CLR-6:	*Understand current developments and future prospects of Fiber Optics*

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 identify optical properties*	*2*	*80*	*75*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*M*	*H*	*H*	*H*	*H*
CLO-2:	*Enable the students to explore the field of optics*	*2*	*80*	*70*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*M*	*H*	*H*	*H*	*H*
CLO-3:	*Understand the concepts in modern optics and laser technology*	*2*	*75*	*70*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*M*	*H*	*H*	*H*	*H*
CLO-4:	*Apply the techniques of diffraction and holography in 3D recording process*	*2*	*80*	*75*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*M*	*H*	*H*	*H*	*H*
CLO-5:	*Understand the basic concepts in interference and optical sensors*	*2*	*80*	*70*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*M*	*H*	*H*	*H*	*H*
CLO-6:	*Utilize the concept of laser light to analyze the Fiber optics material*	*2*	*80*	*75*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*M*	*H*	*H*	*H*	*H*

Duration (hour)		24	24	24	24	24
S-1	SLO-1	Huygen's principles and its applications	Interference-General consideration	Diffraction- Preliminary Consideration	Polarization-Malus' Law	Laser principle
	SLO-2	Huygen's Theory	Conditions for interference	Fraunhofer-Single slit diffraction	Production of polarized light	Einstein coefficient and optical amplification
S-2	SLO-1	Rectilinear Propagation	Coherence	Fraunhofer-Double slit diffraction	The nature of polarized light	Population Inversion and metastable state
	SLO-2	Law of reflection and refraction	Temporal and Spatial Coherence	Fraunhofer-Many slit diffraction	Polarizer	Fiber laser
S-3	SLO-1	Application of Huygen's Principle to study reflection	Coherence Time and Linewidth via Fourier Analysis	Fraunhofer approximation	Dichroism	Ruby Laser
	SLO-2	Application of Huygen's Principle to study refraction	The Fresnel-Argo Laws	Fraunhofer-diffraction by long narrow slit	Birefringence	Typical parameters of ruby laser
S-4	SLO-1	Huygen's Principle in Homogenous media	Young's experiment	Fraunhofer-diffraction by rectangular aperture	Scattering and polarization	He-Ne Laser
	SLO-2	Solving Problems: Huygen's principle	Interference pattern produced on the surface of water	Fraunhofer-diffraction by circular aperture	Polarization by reflection	Optical resonator
S-5 to S-8	SLO-1	Basics of Experimentations	Spectrometer i-i' curve	Determination of dispersive power of a prism using spectrometer	Spectrometer - Narrow angled prism	Revision of experiments
	SLO-2					
S-9	SLO-1	Fermat's principles and its applications	Fresnel's Two-mirror arrangement	Fresnel diffraction	Circular polarizer	Total Internal Reflection
	SLO-2	Law of reflection from Fermat's Principle	Fresnel's Biprism	Fresnel half-period zone	Polarization of polychromatic light	The Optical Fiber
S-10	SLO-1	Law of refraction from Fermat's principle	Inference with white light	The Fresnel zone plate	Interference of polarized light; quarter and half waveplate	The Coherent Bundle
	SLO-2	The modern formulation of Fermat's principle	Displacement of Fringes	Fresnel Diffraction-More Rigorous Approach	Analysis of polarized light	The numerical aperture
S-11	SLO-1	Ray paths in an inhomogeneous medium	Interference by plane parallel film when Illuminated by a plane Wave	Fresnel-Integrals & rectangular Aperture	The phenomenon of double reflection	Attenuation in optical fibers
	SLO-2	The Phenomenon of Mirage	Interference by a Plane Parallel Film when Illuminated by point source	Fresnel-diffraction by circular aperture	Plane Wave Propagation in Anisotropic Media	Guided modes of step index fiber
S-12	SLO-1	Solving Problems: Mirage effect	Interference by Film with Two Non-parallel Reflecting Surfaces	A Gaussian beam propagation	Ray Velocity and Ray Refractive Index	Single mode fibers
	SLO-2	Prisms	Newton's ring	Diffraction of plane wave by long narrow slit and transition to the Fraunhofer region	Non-linear optics - Basics	Pulse dispersion in single mode optical fiber
S-13 to S-16	SLO-1	Determination of wave lengths of mercury spectrum using prism in minimum deviation	Determination of wave lengths of mercury spectrum using diffraction grating in minimum deviation	Determination of refractive index of the material of the prism by drawing the i-d curve	Spectrometer – refractive index of the liquid	Determination of numerical aperture and acceptance angle of the optical fiber using laser
	SLO-2					
S-17	SLO-1	Brewster's angle	Solving Problems; Newton's ring	Holograph-Basic Theory	Solving Problem: Half waveplate	Multi-mode fibers

	SLO-2	Refraction at a Single Spherical Surface	Michelson Interferometer	Some applications of holography	Solving Problem: quarter waveplate	Pulse dispersion in multi-mode optical fiber
S-18	**SLO-1**	Reflection by a Single Spherical Surface	Mirrored interferometer	Solving problem: Fraunhofer diffraction	Thin-lens Equations	Fiber optic sensors
	SLO-2	Fresnel Equation-Derivation	Mach-Zender Interferometer	Solving problem: Fresnel diffraction	Thin-lens combination	Applications of fiber optics
S-19	**SLO-1**	Fresnel Equation-Different cases	Multiple beam interferometer	Circular Obstacles	The principle foci and focal length of a lens	Solving problem: He-Ne laser
	SLO-2	Fresnel Equation-Interpretation: Reflectance and Transmittance	Fabry-Perot interferometer	Fresnel Diffraction-More Rigorous Approach	The Newton formula	Solving problem: Fiber optics
S-20	**SLO-1**	Solving Problem: Fresnel Equation	Resolving power	Fresnel diffraction by a narrow obstacle	Lenses-Refraction and Reflection at single spherical surface	Solving problem: Ruby Laser
	SLO-2	Solving Problem: Brewster's angle	Solving Problems; Resolving Power	Diffraction at the straight edge	Solving Problem: Thin-lens Equations	Solving problem: Numerical aperture
S-21 to S-24	**SLO-1**	Determination of thickness of thin wire air-wedge	Determination of wavelength of sodium light – Newton's Rings	Determination of wave lengths of mercury spectrum using diffraction grating in normal incidence	Repeat/Revision of experiment	Spectrometer - Cauchy's constants

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 %	40 %	40 %	40 %	40 %	40 %	40 %	40 %	40 %
	Analyze										
Level 3	Evaluate	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

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

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. N Vijayan, NPL, nvijayan @nplindia.org	Prof. V Subramanian, IIT Madras, manianvs@iitm.ac.in	Dr. JunaidMasudLaskar, SRMIST
Mr. R Seshadri, Titan Company Limited, seshadri@titan.co.in	Prof. C Vijayan, IIT Madras, cvijayan@iitm.ac.in	Dr. Kesavan, SRMIST

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Course Code	UPY20502T	Course Name	Statistical Mechanics	Course Category	C	*Core Course*	L	T	P	C
							4	2	0	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:	*Acquire a firm understanding of basicconceptsof statistical mechanics*	1
CLR-2:	*Abstract from classical theories the thermodynamics of radiation*	
CLR-3:	*Introduce the fundamental basis governing the exchange of energy with thermal radiation*	
CLR-4:	*Comprehend the principles of quantum statistics: Bose Einstein statistics*	
CLR-5:	*Broaden the understanding in Fermi Dirac statistics*	
CLR-6:	*Develop skill in the applications of statistical distributions in real life situations*	

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 problem solving skills to determine entropies, specific heat capacities of classical gas.*	*2*	*80*	*75*
CLO-2:	*Apply the classical laws of radiative transfer in real situations*	*2*	*80*	*70*
CLO-3:	*Analyze the concepts of quantum thermodynamics of radiation*	*2*	*75*	*70*
CLO-4:	*Apply the theory of Bose -Einstein distribution to explain condensation of cold gases*	*2*	*80*	*75*
CLO-5:	*Solve the occupancy of fermions in different quantum systems*	*2*	*80*	*70*
CLO-6:	*Compare the statistical distribution laws and to apply the appropriate one in solving physical problems*	*2*	*80*	*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	PSO - 1	PSO - 2	PSO - 3
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	M	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H

Duration (hour)		18	18	18	18	18
S-1	SLO-1	Basics of probability and statistics: probability distributions	Classical thermodynamics of electromagnetic radiation	Quantum Theory of Radiation	Failure of classical statistics	Fermi energy
	SLO-2	Postulates of statistical mechanics: equal apriori probability	Definitions of radiation measures and magnitude system	Density of States	Features of quantum statistics	Dependence of Fermi energy on m N and V
S-2	SLO-1	Interactions between macroscopic systems –microstate and macro states	Basics of radiative transfer	Relativistic Systems	Bose-Einstein Statistics	Wave function and spin of fermions
	SLO-2	Elementary concepts of ensembles and phase space	Modes of heat transfer	Radiation Transfer between surfaces	Symmetry considerations	Pauli's exclusion principle
S-3	SLO-1	Entropy and thermodynamic probability	Interaction of radiation with conduction and convection	Radiation through semitransparent materials	Indistinguishable bosons	Fermi-Dirac Statistics
	SLO-2	Boltzmann thermodynamic equation S=KlnW	Interaction of radiation with radiation	Net radiation exchange among surfaces	Most probable distribution	Fermi-Dirac Distribution function
S-4	SLO-1	Molecular partition function	Properties of Thermal Radiation	Photons: Blackbody Radiation	Partition function	Fermi-Dirac Distribution Law
	SLO-2	Translational part of Boltzmann partition function	Pure temperature dependence.	Black body properties at interfaces	Photon gas	Occupation of energy states
S-5	SLO-1	Numerical to find the most probable distribution for a classical gas	Numerical to find the energy of a photon	Review of properties of black body in various surfaces	Numerical to find the most probable distribution for Bosons	Problems related to Fermi energy
	SLO-2	Numerical to calculate the entropy using Boltzmann equation	Conversion of wavelength, frequency and energy of radiation	Comparison of radiative transfer at different surfaces	Problems based on calculation of partition function	Numerical related to Fermi-Dirac Distribution function
S-6	SLO-1	Determining the probability distribution for classical gases	Solving problems related to conduction	Solving numerical related to radiative energy transfer	Solving problems to calculate the energy of photon gas	Numerical related to Fermi distribution law
	SLO-2	Solving problems related to molecular partition function	Solving problems related to radiation	Comparison of classical and quantum theory of radiation	Determination of symmetry of wave f unction by interchange of number of bosons	Problems related to Occupation of energy states
S-7	SLO-1	Maxwell-Boltzmann distribution law	Absorptivity,	Transmissivity of black bodies	Photon energy spectrum: average photon energy	Chemical potential
	SLO-2	Thermodynamic functions of an ideal gas	Emissivity,	Emissivity of black bodies and gray bodies	Photons in an oven	Comparison of 3 statistics
S-8	SLO-1	Classical entropy	Reflectivity	Spectral Distribution of Black Body Radiation	Degenerate Bose gas	Properties of an ideal Fermi Dirac gas
	SLO-2	Mixture of gases	Spectral energy density	Planck Distribution of radiation	B-E distribution law	Thermodynamic functions of a Completely and strongly Degenerate Fermi Gas
S-9	SLO-1	Gibbs paradox(qualitative)	Kirchhoff's law.	Planck's Quantum Postulates	Thermodynamic functions of a strongly Degenerate Bose gas	Ultracold degenerate Fermi gas
	SLO-2	Sackurtetrode equation(qualitative)	Stefan-Boltzmann law: Thermodynamic proof.	Planck's Law of Blackbody Radiation	Bose Einstein condensation	Fermi temperature of the gas
S-10	SLO-1	Internal degrees of freedom	Radiation Pressure.	Experimental verification	Properties of liquid He (qualitative description)	Classical limit of Fermi gas
	SLO-2	Gibb's phase rule	Wien's Displacement law	Deduction of Wien's Distribution Law from Planck's law.	Superfluidity of liquid helium	Electron gas in a Metal
S-11	SLO-1	Calculation of degrees of freedom for monoatomic diatomic and polyatomic gases	Determination of spectral energy density	Representation of spectral distribution of black body radiation	Numerical related to finding the number of available energy states.	Problem solving on Fermi temperature of a gas
	SLO-2					
S-12	SLO-1	Solving the numerical related to entropy of gases	Solving the numerical related to Kirchhoff's law	Solving numerical related to Planck's law	Problems related to Thermodynamic functions of Bose gas	Problems related to Thermodynamic functions of Fermi gas
	SLO-2					
S-13	SLO-1	Average kinetic energy of a particle	Spectral radiance of a black body	Deduction of Rayleigh-Jeans Law from Planck's law.	Laser cooling	Electronic heat capacity
	SLO-2	Law of equipartition of energy (with proof)	Wien's Distribution Law.	Deduction of Stefan-Boltzmann Law from Planck's law.	Evaporative cooling	Specific Heat of Metals
S-14	SLO-1	Specific heat capacities of gases	Saha's Ionization Formula.	Calculation of modes	Radiation as a photon gas	Relativistic Fermi gas
	SLO-2	Applications of specific heat and its limitations	Thermal ionization potential	Deduction of Wien's displacement law from Planck's law.	Thermodynamic functions of photon gas	Ultra-relativistic limit
S-15	SLO-1	Thermodynamic functions of a two-energy levels system	Transition rates	Wiens explanation	Bose derivation of Planck's law	Fermi liquid
	SLO-2	Schottky anomaly	Rayleigh-Jean's Law.	The Cosmic microwave background radiation	Bose temperature	Electron degeneracy pressure
S-16	SLO-1	Negative temperatures	Ultraviolet Catastrophe.	Absorption and emission processes	Heat capacity of a Bose-Einstein gas	White Dwarf Stars
	SLO-2	Negative Kelvin materials	Planck's explanation	Einstein's co-efficient	Derivation of heat capacity	Chandrasekhar Mass Limit
S-17	SLO-1		Review of radiation principles	Review of cosmic radiation		

	SLO-2	Problems: Numerical related to calculation of specific heat capacities			Problems related to energy in a photon spectrum	Problems: Numerical related to specific heat capacity of metals
S-18	SLO-1	Problems: Statistical interpretation of negative temperatures	Overview of laws of thermal radiation	Overview of Einstein's relations	Problems related to specific heat capacities	Problems: Numerical related to electronic heat capacity of metals
	SLO-2					

earning Resources

1. Statistical Mechanics, R. K. Pathria and P.D. Beale, (Academic Press,3rd edn., 2011).
2. Fundamentals of Statistical Mechanics, BB Laud (New Age International Publishers, 1998)
3. Statistical Mechanics, K. Huang, (John Wiley Asia, 2000).
4. Thermodynamics and Statistical Mechanics, W. Greiner, L. Neise, and H. Stocker, (Springer, 1995).
5. Equilibrium Statistical Mechanics, M. Plishke and B. Bergersen, (World Scientific, 2nd Ed. 1994).
6. Introduction to Modern Statistical Mechanics, D. Chandler, (OxfordUniversityPress, 1987).

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, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications 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.Annesujatha, SRMIST

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Course Code	UPY20D07T	Course Name	Radiation Physics	Course Category	D	Discipline Specific Elective Course	L	T	P	C
							4	2	0	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		
		1	2	3
CLR-1 :	*Understand the principles of Radiation Physics.*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*Understand the radiation dosimetry and its importance.*			
CLR-3 :	*Enable the student to have a deep knowledge of the fundamentals of radiation generators, dosimeters and therapy*			
CLR-4 :	*Explore the concept of Biomedical Applications of Radiation Physics*			
CLR-5:	*Discuss nuclear and radiation physics applications in medical diagnostics*			
CLR-6:	*Understand current developments and future prospects of Radiation Physics*			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning		
		1	2	3
CLO-1 :	*Focus on the application of Radiation Physics to clinical medicine and therapy*	2	80	75
CLO-2 :	*Develop particular expertise in applications of Radiation Physics.*	2	80	70
CLO-3 :	*Study diagnostic and therapeutic applications like radiation dosimetry, X-ray technology, MRI etc.*	2	75	70
CLO-4 :	*Gain knowledge with reference to working of various diagnostic tools*	2	80	75
CLO-5:	*Acquire functional knowledge regarding need for radiological protection, therapeutic and radiation safety practices*	*2*	*80*	*70*
CLO-6 :	*Explore applications of nuclear and radiation physics relevant to society*	*2*	*80*	*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	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-2 :	H	H	H	H	M	H	H	H	M	H	M	H	H	H	H
CLO-3 :	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-4 :	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-5:	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-6 :	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H

Duration (hour)		18	18	18	18	18
S-1	SLO-1	Structure of matter-atom - Nucleus, atomic mass and energy units	Absorption of energy	Ionization chamber	Dose distribution and scatter analysis	External Beam Therapy (Basic Idea):
	SLO-2	Distribution of orbital electrons	Interaction of radiation with matter	(Thimble chamber, condenser chamber),	Phantoms	Telecobalt
S-2	SLO-1	Atomic Energy Levels	Photoelectric effect	Measurement of absorbed dose	Functions used in dose calculations	Modern Radiation Therapy
	SLO-2	Nuclear Energy Levels	Photoelectric absorption (qualitative picture)	in ionization Chamber	Tissue air ratio (TAR) (qualitative)	Image Guided Radiation Therapy
S-3	SLO-1	Electromagnetic spectrum	Photon beam	Effects of T and P on ionization measurements	Percent depth dose (qualitative)	Conformal Radiation Therapy (CRT),
	SLO-2	Particles and Radiations: Quantum Nature	Narrow and Broad Beams	The Roentgen	Inverse square law (qualitative)	Proton Therapy
S-4	SLO-1	Decay of radioactive Isotopes	Linear attenuation coefficient	Measurements:	Back scatter factor (qualitative)	Gamma Knife

	SLO-2	Half-life	Definition of mass, electronic and atomic attenuation coefficients	Dose in free space and Phantom	Tissue phantom ratio (TPR) (qualitative)	Cyber Knife
S-5	**SLO-1**	Problem Solving: Atomic physics	Problem Solving: Photoelectric effect	Problem Solving: Ionization Chambers	Problem Solving: TAR	Problem Solving: Beam Therapy
	SLO-2	Problem Solving: Nuclear physics	Problem Solving: Photon Beams	Problem Solving: Ionization Chambers	Problem Solving: TPR	Problem Solving: Beam Therapy
S-6	**SLO-1**	Problem Solving: Radioactivity	Problem Solving: Attenuation	Problem Solving: Ionization measurements	Problem Solving: Dose depth	Problem Solving: Imaging
	SLO-2	Problem Solving: Radioactivity	Problem Solving: Energy loss	Problem Solving: Dose measurements	Problem Solving: Inverse square law	Problem Solving: Gamma Knife
S-7	**SLO-1**	Radioactive Disintegration	Compton scattering	Energy Fluence	Dose calculation For patients	Radiation Protection
	SLO-2	Disintegration Constant	Compton Cross-sections	Relation with energy exposure	Percent depth dose, TPR, TAR	Dose Equivalent
S-8	**SLO-1**	X-ray characteristic radiation	Pair Production	Geiger Muller counter	Isodose curves	Effective Dose Equivalent
	SLO-2	Energy Spectra	Energy distribution in pair production	Working and application	examples	Background of Radiation
S-9	**SLO-1**	production of x-rays	Photo disintegration	Scintillation counters	Calculation of does at any point	Low level Radiation effects
	SLO-2	X-ray line Spectra	Total attenuation coefficient	Qualitative idea of working principle	determination of all factors	Effective Dose Equivalent limits
S-10	**SLO-1**	Bremsstrahlung interactions	Quality of X-Ray Beams	Solid State detectors	Direct patient dose calculations	Quality factor
	SLO-2	Efficiency of X-ray Production	Effects of filters	Working and application	determination of all factors	Harmful effects of ionizing radiation
S-11	**SLO-1**	Problem Solving: Spectra	Problem Solving: Compton scattering	Problem Solving: Radiation exposure	Problem Solving: Dose Calculations	Problem Solving: Dose Equivalent
	SLO-2	Problem Solving: X-ray emission	Problem Solving: Compton X-section	Problem Solving: GM Counter	Problem Solving: Dose Calculations	Problem Solving: Effective Dose Equivalent
S-12	**SLO-1**	Problem Solving: Efficiency	Problem Solving: Photo disintegration	Problem Solving: Solid state detectors	Problem Solving: Dose Calculations	Problem Solving: Effective Dose Equivalent limits
	SLO-2	Problem Solving: Bremsstrahlung	Problem Solving: Total attenuation coefficient	Problem Solving: Solid state detectors	Problem Solving: Dose Calculations	Problem Solving: Quality factor
S-13	**SLO-1**	X-ray Tubes	Radiation units exposure	Thermo luminescent Dosimetry	Radiation therapy	Occupational Limits
	SLO-2	Design and cooling	Absorbed dose	TLD- Qualitative Facts	Available techniques	Public Dose Limits
S-14	**SLO-1**	Coolidge tube	Units: rad, gray	Films as Dosimeters	Computed Tomography	Biological effect of radiation
	SLO-2	Rotating anode x-ray tube	relative biological effectiveness	Qualitative overview	Working and application	Tissues at risk
S-15	**SLO-1**	X-ray circuit	effective dose	Chemical Dosimetry	Magnetic Resonance Imaging	Protective barriers
	SLO-2	voltage rectification Half wave and full wave rectification	Rem & Sievert	Qualitative Facts	Principle of MRI, Total skin electron irradiation	Qualitative overview
S-16	**SLO-1**	Types of X-Ray Generator	inverse square law	Direct Measurement of absorbed dose	Ultrasound-	Protection from radiation from small sources
	SLO-2	high frequency generator	Effective dose vs Equivalent dose	Calorimeters	Working and application	Personnel Monitoring
S-17	**SLO-1**	Problem Solving: X-ray tubes	Problem Solving: Radiation units	Problem Solving: Dosimetry	Problem Solving: Radiation Therapy	Problem Solving: Dose Limits
	SLO-2	Problem Solving: X-ray tubes	Problem Solving: Radiation dose	Problem Solving: Dosimetry	Problem Solving: Magnetic Resonance	Problem Solving: Dose Limits
S-18	**SLO-1**	Problem Solving: Rectification	Problem Solving: Radiation units	Problem Solving: Dosimetry	Problem Solving: Tomography	Problem Solving: Tissue Damage
	SLO-2	Problem Solving: X-ray circuits	Problem Solving: Radiation dose	Problem Solving: Dosimetry	Problem Solving: Ultrasound	Problem Solving: Protection barriers

Learning Resources	1. The Physics of Radiology, H E Johns and Cunningham Charles, (C Thomas Pub Ltd, 4 editions, 1983) 2. The Physics of Radiation Therapy, FiazM.Khan and J.P. Gibbons (Lippincott Williams and Wilkins, 5th Edition, 2014).	3. Fundamental Physics of Radiology, Meredith W.J. and J.B. Massey, (John Wright and Sons Ltd., 3rd Edition, 1983). 4. Radiation Therapy Physics, WilliamR.Hendee, GeofferyS.Ibbott and EricG.Hendee, (John Wiley and Sons.,Inc, 3rd Edition, 2005). 5. Atomic Nucleus, R. D. Evans, (Textbook Publications, 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 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
Dr. M Krishna Surendra, Saint Gobain Research, krishana.muvvala@saint-gobain.com	Prof. C Vijayan, IIT Madras, cvijayan@iitm.ac.in	Dr.Kesavan, SRMIST
Mr. Navneethakrishanan, CLR Laboratories Pvt Ltd.	Prof. R Gnanamoorthy, IITMadras ,gmoorthy@ iitm.ac.in	Dr.RohitDhir, SRMIST

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Course Code	UPY20D08T	Course Name	Plasma Physics	Course Category	D	Discipline Specific Elective Course	L	T	P	C
							4	2	0	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:
CLR-1:	*Learn the basic character of plasma.*
CLR-2:	*Understand the motion of charged particle in plasma.*
CLR-3:	*Learn the dynamic of plasma through kinetic theory*
CLR-4:	*Understand plasma phenomena through Fluid dynamics*
CLR-5:	*Understand the concept of wave propagation in plasma*
CLR-6:	*Acquire knowledge on measurement methods of plasma characteristics*

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 knowledgeof plasma for identification and characterization of plasma*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-2:	*Able apply the principle to develop confinement methods*	2	80	70	H	M	M	H	M	H	H	H	M	H	M	H	M	M	M
CLO-3:	*Use the theory to explain new observations in plasma*	2	75	70	H	M	H	H	H	H	H	M	H	H	M	H	H	H	H
CLO-4:	*Apply the principle to identify existing new phenomena*	2	80	75	M	H	H	M	H	H	H	H	H	H	M	H	H	H	H
CLO-5:	*Able to apply the concept to study the effect wave propagation in different application*	2	80	70	H	H	H	H	H	M	H	H	M	H	M	H	H	H	H
CLO-6:	*Use measurement tool to calculate plasma parameters and apply to design issues*	2	80	75	H	H	H	M	H	M	H	H	M	H	M	H	H	M	H

Duration (hour)		18	18	18	18	18
S-1	SLO-1	Introduction to Plasma - Its definition	Introduction to Kinetic Theory of Plasma	Introduction the Fluid theory of plasma	Introduction to MHD Equations	Introduction to Plasma Diagnostics
	SLO-2	Composition and characteristics	Distribution Function	Introduction to convective derivative	Conservation laws and MHD Equations	Remote Diagnostics Methods
S-2	SLO-1	Microscopic description of plasma	Property of Distribution Function, Differential Flux	Fluid equation using convective derivative	Single Fluid MHD Equation	Electromagnetic wave characteristics in plasma
	SLO-2	Macroscopic description of plasma	Velocity Distribution Functions	Plasma pressure and Fluid equation	Ideal MHD Equation	Optical Diagnostics Methods
S-3	SLO-1	Motion of charged particle in uniform electric field	The meaning of f (v)	Complete Set of Fluid Equation	Density Gradient and Magnetic Pressure	Frequency Dependence of Plasma Waves on density
	SLO-2	Motion of charged particle in uniform magnetic field	The meaning of f (v) Equations using Kinetic theory	Perpendicular fluid Drift	Magnetic Pressure and Characteristics	Microwave Interferometry
S-4	SLO-1	Motion of charged particle in uniform electric and magnetic field	Vlasvov Equation	Diamagnetic Drift, Diamagnetic current Density J_D	Flux lines in Plasma	Laser induced Fluorescence
	SLO-2	Motion of charged particle and E x B-drift	Interpretation of Vlasvov Equation	Perpendicular drift and Boltzmann Relation	Flux Freezing	Laser Interaction with plasma
S-5	SLO-1	Problem solving: Microscopic characteristics	Problem solving: Distribution Function	Problem solving: Fluid Equation	Problem solving: MHD Equation	Problem solving: Frequency of dependence
	SLO-2	Problem solving: Macroscopic characteristics	Problem solving: Velocity Distribution Functions	Problem solving: Convective Derivative	Problem solving: Ideal MHD Equation	Problem solving: Density dependence of EM wave
S-6	SLO-1	Problem solving: Motion in Uniform field	Problem solving: Vlasvov Equation	Problem solving: Fluid Drift	Problem solving: Magnetic Pressure	Problem solving: EM wave characteristics
	SLO-2	Problem solving: Motion in External magnetic field	Problem solving: Vlasvov Equation	Problem solving: Diamagnetic Drift	Problem solving: Flux Freezing	Problem solving: EM wave Scattering
S-7	SLO-1	Effect of a transverse force on charged particle	Equation of Fluid Motion	Plasma-Space charge oscillation	Introduction to Solar wind	Intensity dependence Fluorescence

	SLO-2	Drift due to a transverse force	Derivation of Equation of Fluid Motion	Derivation of Plasma Frequency	Characteristic of Solar wind	Intensity/wave length dependence Scattering
S-8	**SLO-1**	Magnetic field inhomogeneity	Collisions	Ion Oscillation in Plasma	Studies on solar wind models	Langmuir Probes
	SLO-2	Magnetic field spatial inhomogeneity	Plasma Oscillations	Ion Acoustics waves	Parker model of Solar wind	Construction and circuit
S-9	**SLO-1**	Magnetic field Curvature inhomogeneity	Oscillation and Damping	Waves in Plasma	Introduction to Magnetic Reconnection	The I-V Curve
	SLO-2	Magnetic Curvature Drift	Collision less Damping	Classification and condition for wave plasma	Magnetic Reconnection in Plasma	The Transition Region
S-10	**SLO-1**	Need of confinement of plasma	Landau Damping	Propagation of Electrostatic wave (Oscillation perpendicular to B)	Condition of Magnetic Reconnection	Electron saturation - Space potential
	SLO-2	Types of Magnetic confinement of plasma	Landau Damping Derivation	Dispersion relation for plasma wave	Derivation of Magnetic Reconnection Expression	Floating Potential Ion saturation current
S-11	**SLO-1**	Problem solving: Motion in transverse filed	Problem solving: Fluid Equation	Problem solving: Plasma Oscillation	Problem solving: Solar wind	Problem solving: Intensity dependence of fluorescence
	SLO-2	Problem solving: Drift in transverse filed	Problem solving: Collision in plasma	Problem solving: Plasma Frequency	Problem solving: Parker Model	Problem solving: Wavelength dependence of scattering
S-12	**SLO-1**	Problem solving: Magnetic inhomogeneity	Problem solving: Collision Less Damping	Problem solving: Acoustics Waves	Problem solving: Magnetic reconnection	Problem solving: I-V Curve
	SLO-2	Problem solving: Curvature Drift	Problem solving: Landau Damping	Problem solving: Electrostatic Waves	Problem solving: Magnetic Reconnection in plasma	Problem solving: Electron Saturation
S-13	**SLO-1**	Magnetic Mirror	BGK modes	Electromagnetic waves	Astrophysical Magnetic field	Distribution functions
	SLO-2	Magnetic Mirror confinement	Condition for undamped plasma waves	Dispersion relation for Electromagnetic waves	MHD dynamo-Homopolar Dynamo Theory	RF compensation
S-14	**SLO-1**	Collision processes in Plasma	Amplitude of BGK modes	Electromagnetic Waves with B_0=0	Magnetic Reconnection and Dynamo Action	Double probes and hot probe
	SLO-2	Non Coulomb collisions in Plasma	Von-Kampen Modes	Dispersion relation	Magnetic field due to polar filed	Other Local Diagnostics
S-15	**SLO-1**	Pinch in Plasma, The Theta pinch ,	Experimental Detection of Landau damping	MHD Waves Alfven Waves	Interplanetary Magnetic Field	Magnetic probes
	SLO-2	The Z- pinch, The screw pinch	Malmberg and Wharton Study of Landau Damping	Magneto sonic Waves	Origin and extent	Energy analyzers
S-16	**SLO-1**	Solar corona and Solar wind	Derfler and Simonen Study of Landau Damping	Instability-Definition and Types	Mass loss by Interplanetary Magnetic field	RF current probe-
	SLO-2	Van Allen radiation belt.	Damping study from frequency dependence of wave vector	Rayleigh Tailor instability	Angular momentum loss	Plasma oscillation probe
S-17	**SLO-1**	Problem solving: Magnetic confinement	Problem solving: Undamped Waves	Problem solving: Electromagnetic Waves	Problem solving: Astrophysical Magnetic Field	Problem solving: Ion Saturation Current
	SLO-2	Problem solving: Collision process	Problem solving: Von Kampen modes	Problem solving: MHD Waves	Problem solving: MHD Dynamo	Problem solving: RF compensation
S-18	**SLO-1**	Problem solving: No coulomb collision	Problem solving: frequency dependence of wave vector	Problem solving: Alfven Waves	Problem solving: Interplanetary Field	Problem solving: Hot probe
	SLO-2	Problem solving: Pinch effect	Problem solving: Variation of Resonant particles with velocity distribution	Problem solving: Instability	Problem solving: Angular momentum loss	Problem solving: Energy Analyzer

Learning Resources	1. Introduction to Plasma Physics, Gurnett D. A. and A. Bhattacharjee, (Cambridge, 2005). 2. Fundamentals of Plasma Physics, Paul M. Bellan, (Cambridge University Press, 2006). 3. Introduction to Plasma and Controlled Fusion, Frencies F chen, (Plenum Press, 1984).	4. The Physics of Plasmas, Richard Fitzpatrick, (Online book, 2011) 5. Topics in Plasma Diagnostics, Podgomyl I M, (Plenum Press, 1971) 6. An Introduction to Plasma Astrophysics and Magneto hydrodynamics, Marcel Goossens, (Springer, 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 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
Dr. M Sathish, CSIR-CECRI, msathish@cecri.re.in	Prof. C Vijayan, IIT Madras, cvijayan@iitm.ac.in	Dr.T. Sahoo, SRMIST
Dr. N Vijayan, NPL, nvijayan @nplindia.org	Prof. V Subramanian, IIT Madras, manianvs@iitm.ac.in	Dr. Mohamed Ameen, SRMIST

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Course Code	UPY20D09T	Course Name	Astrophysics	Course Category	D	Discipline Specific Elective Course	L	T	P	C
							4	2	0	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:
CLR-1:	*Learn the fundamental knowledge about the astronomical units and geometrical coordinate of solar and planetary systems and related events*
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*
CLR-6:	*Solve problems utilizing the knowledge of Astrophysics and related concepts*

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:	*Perceive the basics of astronomy and Astrophysics*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-2:	*Account for the real facts and features of all astronomical object and events*	2	80	70	H	H	H	H	M	H	H	H	M	H	M	H	H	H	H
CLO-3:	*Relate the acquired knowledge to celestial objects*	2	75	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-4:	*Analyze the data as per the Observation techniques in modern astronomy*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-5:	*Solve problems in modern Astronomy and Astrophysics*	2	80	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-6:	*Apply the different physical laws to the astronomical systems*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H

Duration (hour)		18	18	18	18	18
S-1	SLO-1	History of astronomy	Revisiting Newtons laws	The Sun, Our Star	Structure of the Solar System	A Universe of Galaxies
	SLO-2	Knowledge of Planetary Neighborhood and Solar system	Kepler's Laws (qualitative idea)	Various Properties	Components of the Solar System	Early Observations
S-2	SLO-1	Astronomical Numbers and Units	Stellar Parallax	Hydrostatic Equilibrium: Pressure Balance	Age of the Solar system	Distances of Galaxies
	SLO-2	Approximations	Method of determination	Sun's Interior	Formation of the planets: The Nebular Model	Standard Candles (Cepheids and SNe Type1a)
S-3	SLO-1	Celestial Sphere	Magnitude scale: Brightness, Radiant Flux and Luminosity	Solar Atmosphere	The Terrestrial Planets	Cosmic Distance Ladder
	SLO-2	Introduction: Astronomical and Geographical Coordinate Systems	The Period Luminosity (P-L) Relation	Energy Transport	Jovian planets	Gravitational redshift: Hubble's Law
S-4	SLO-1	Horizon System	Determination of Temperature	Sun's Energy Cycle	precession of earth gas planets (Jupiter Saturn)	Classification of Galaxies
	SLO-2	Equatorial System	Radius of a stars	Solar Neutrinos	precession of earth gas planets (Neptune Uranus)	Qualitative Ideas
S-5	SLO-1	Quiz on Astronomical History	Quiz on Newtonian Mechanics	Quiz on the Sun	Quiz on Structure of the Solar System	Quiz on Universe
	SLO-2	Quiz on Knowledge of Solar System and Galaxy	Problem solving: stellar parallax	Quizthe Sun and its atmosphere	Quiz on Components of the Solar System	Problem solving: Redshift
S-6	SLO-1	Problem solving: Astronomical Units	Problem solving: Brightness, Radiant Flux	Problem solving: Energy Transport	Quiz on Formation of the planets	Problem solving: Hubble's Law
	SLO-2	Problem solving: Astronomical approximations	Problem solving: Temperature and radius of star	Problem solving: Sun's energy cycle	Quiz on the planets	Problem solving: Hubble's Law
S-7	SLO-1	Annual Motion of the Sun	Classification of binary stars	Solar Seismology	Asteroid belt and its concepts	Concepts and Definitions: Galaxy Clusters
	SLO-2	Seasons	Determination of Masses from Binary orbits	Sun spots	Kuiper belt and its concepts	Super Clusters
S-8	SLO-1	Basic Definitions: The Ecliptic's Tilt	Doppler Shift	Sun Flares	Oort cloud	Concepts and Definitions: Active Galaxies
	SLO-2	Equinoxes and Solstice	Stellar Spectral Classification	Solar Cycle	Facts about the Oort Cloud and its location	Quasars
S-9	SLO-1	Precession	Hertzsprung-Russell Diagram	Overview of Stellar Evolution	Planetary Rings	What is Dark Matter?
	SLO-2	Time and timekeeping	Organization of stars according to spectral series	Stages of star's formation	Extra-Solar Planets	Dark matter in Cluster of Galaxies qualitative overview

S-10	**SLO-1**	Basic Definitions: Calendar Weeks, Months Years, Leap Years	Basic Definitions: Magnification Light Gathering Power, Resolving Power	Tracking changes with HR diagram	Comets-Meteors,	Cosmology- Concept of Evolution of universe
	SLO-2	Sidereal Time	Diffraction Limit, Atmospheric Windows	Star Evolution Cycle	Meteorites	Meaning of Red Shift and Age of Universe
S-11	**SLO-1**	Problem solving: Seasons	Problem solving: Doppler Shift	Quiz on the Sun spots flares	Quiz onon Asteroid and Kuiper Belts	Assignment/Seminar on any of the above topics
	SLO-2	Problem solving: Equinoxes and Solstice	Problem solving: HR diagram	Quiz on the Stellar Evolution	Quiz on the Oorts Cloud	Quiz on Dark Matter/Energy
S-12	**SLO-1**	Problem solving: Equinoxes and Solstice	Problem solving: HR diagram	Problem solving: Stages of star's formation	Quiz on the planetary rings	Problem solving: age of the Universe
	SLO-2	Problem solving: Time and timekeeping	Problem solving: Binary systems	Problem solving: Star energy cycle	Assignment/Seminar on any of the above topics	Problem solving: evolution of the Universe
S-13	**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	Mass limits	Properties of the Milky Way	Visible Universe
S-14	**SLO-1**	Lunar Eclipses	reflective and refractive Phenomena in telescopes	Supernovae (mass limits)	Mass and Density	Concepts and Definitions: the Big Bang
	SLO-2	Solar Eclipses	Errors and rectification in telescopes	Classifications of Supernovae	Stars and Star Clusters of the Milky Way	Cosmic Microwave Background
S-15	**SLO-1**	Shape and Size of Earth	Limitations of telescopes	Concepts and Definitions: White Dwarfs and Supernovae remnants	Galactic Nucleus	Concepts and Definitions: Beginning of the universe and various stages
	SLO-2	Measuring the diameter of astronomical objects	X-ray observation techniques Gamma Ray Astronomy	Neutron stars and Pulsar	Edge of the Milky Way	Radiation Matter Antimatter, fusion, galaxy formation and present.
S-16	**SLO-1**	Night Sky	Qualitative idea of Detectors	Concepts and Definitions: Black Holes	Density Waves	Idea of Epoch of Inflation
	SLO-2	Constellations	Their Use with Telescopes	Schwarzschild radius	Spiral Arms of the Milky Way	Problems solved by concept of inflation
S-17	**SLO-1**	Problem solving: Sun and Moon's rotation	Problem solving: Magnification/N.A.	Problem solving:Main Sequence stars	Quiz on Structure of the Milky Way	Quiz on Night Sky
	SLO-2	Problem solving: Measurements of diameters	Problem solving: Resolving Power of telescopes	Problem solving: mass limits of stars	Quiz on Properties of the Milky Way	Quiz on Big Bang
S-18	**SLO-1**	Problem solving: Size of planets	Problem solving: Errors and rectification in telescopes	Problem solving: Supernovae	Quiz on the nucleus and edge	Quiz on the inflation
	SLO-2	Quiz: Constellations	Quiz: Telescopes	Quiz: Neutron Stars/Black holes	Assignment/Seminar on any of the above topics	Assignment/Seminar on any of the above topics

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 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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Course Code	UPY20S05L	Course Name	Computer Programming with MATLAB	Course Category	S	Skill Enhancement Course	L	T	P	C
							0	0	4	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		
		1	2	3
CLR-1:	*Familiarize with use of MATLAB as a calculator both for scalars and matrices*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2:	*Use elementary functions and define variables, construct simple scripts and functions, and visualize results*			
CLR-3:	*Gain skills to write and develop simple programs in MATLAB*			
CLR-4:	*Demonstrate skills to use mathematical methods for modeling physical systems*			
CLR-5:	*Estimate the errors in the use of numerical methods*			
CLR-6:	*Describe the results of a simulation in lab reports*			

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:	*Exhibit the skill full usage of MATLAB in developing functions and define variables, construct scripts and functions*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-2:	Visualize and simulate computations and data sets by self-explaining graphics	2	80	70	H	M	M	H	M	H	H	H	M	H	M	H	M	M	M
CLO-3:	*Gain basic programming skills in MATLAB.*	2	75	70	H	M	H	H	H	H	H	M	H	H	M	H	H	H	H
CLO-4:	*Demonstrate basic knowledge of physics in using numerical methods to solve various problems.*	2	80	75	M	H	H	M	H	H	H	H	H	H	M	H	H	H	H
CLR-5:	*Exhibit an understanding of the applicability of mathematical methods for modeling physical systems.*	2	80	70	H	H	H	H	H	M	H	H	M	H	M	H	H	H	H
CLR-6:	*Assert the ability to critically examine and evaluate a model of a physical system.*	2	80	75	H	H	H	M	H	M	H	H	M	H	M	H	H	M	H

DURATION (HOURS)		12	12	12	12	12
S1 to S4	SLO-1	MATLAB Basics: Practice various MATLAB commands, Functions and Plotting	VECTOR ANALYSIS: Exercises on coordinates, vector algebra, dot product, cross product, [3D] rotation of axes	a) Calculation of motion of simple pendulum using the Euler-Cromer method,	Simulation of the electromagnetic radiation emitted from the Sun.	Calculation of the divergence and curl of the electric field surrounding a point charge
	SLO-2		b) DIFFERENTIAL CALCULUS: 1st and 2nd derivatives; gradient; divergence; curl; Laplacian	b) Solution for a non-linear, damped, driven pendulum:the Physical pendulum, using the Euler-Cromer method		
S5 to S8	SLO-1	Creating a simple GUI with input boxes: SHM and the Sine Function DATA ANALYSIS and MATHEMATICAL ROUTINES: Curve fitting: a) Exercises on linear, power and exponential fits.	INTEGRATION: a) Numerical computation of one-dimensional integrals. b) Estimate the value of the integral of the function y = f(x) between x = a and y = b	SATELLITE ORBITS: a) Solving the equation of motion using ode45. b) The continuous spectrum of a blackbody at different temperatures.	Calculation of the potential between two points by the evaluation of the line integral of the electric field: Simulation of Electric Dipole	Simulation of the diffraction of visible light through a double slit
	SLO-2	b) Weighted least squares fit	c) Numerical computation of two-dimensional integrals - double or surface integrals	Simulation of Circular and Elliptical Orbits, and Escape velocity		
S9 to S12	SLO-1	DATA ANALYSIS and MATHEMATICAL ROUTINES: a) Solving Quadratic Equations: GUI and Function call	a) Radioactive decay of uranium. b) The numerical solution of the equations of motion for a simple pendulum using the Euler method	a) Simulation of the blackbody curve of a star. b) Simulation of the radiation emitted from a hot object at four temperatures	Gauss's Law: Calculation of the total electric flux through the closed surface of a cube enclosing five charges randomly located inside the cube.	Solving the one-dimensional Schrodinger Equation for bound states in Potential well and Harmonic Oscillator Potential using a matrix method that evaluates the eigenvalues and eigenfunctions
	SLO-2	b) Stationary Points of a function: Function to find the points of maxima and minima of a curve				

Learning Resources	
	1. Numerical Computing with MATLAB, Cleve Moler (SIAM, 2004) 2. Physical Modeling in MATLAB, Allen Downey (Green Tea Press, 2008; Free book and Codes https://github.com/AllenDowney/PhysicalModelingInMATLAB) 3. Computational Physics, Nicholas J. Giordano, Hisao Nakanishi (2nd Ed. Pearson, 2005) 4. Computational Physics using MATLAB, Kevin Berwick, (free online book with codes:https://www.physics.purdue.edu/~hisao/book/www/Computational%20Physics%20using%20MATLAB.pdf) 5. Doing Physics with MATLAB, Ian Cooper, (Online material with codes: http://www.physics.usyd.edu.au/teach_res/mp/mphome.htm)

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	UPY20S06L	Course Name	Microprocessors and Microcontrollers	Course Category	S	Skill Enhancement Course	L	T	P	C
							0	0	4	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 :	*Understand the architecture of microprocessor and application*	1
CLR-2 :	*Acquire knowledge about the microprocessors and the organization of microprocessor-based systems*	2
CLR-3 :	*Acquire 8085 microprocessor programming skills*	3
CLR-4 :	*Understand the architecture of 8051 microcontroller*	
CLR-5 :	*Acquire 8051 microcontroller programming skills*	
CLR-6:	*Understand interfacing 8085 microprocessor with peripherals*	

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 basic arithmetic instructions in 8085 microprocessor and 8051 microcontroller.*	2	80	75
CLO-2:	*Impart knowledge about data transfer schemes in 8085 microprocessor and 8051 microcontroller.*	2	80	70
CLO-3:	*Understand the basic logical instructions in 8085 microprocessor and 8051 microcontroller.*	2	75	70
CLO-4:	*Implementation of mathematical formulae through instructions*	2	80	75
CLO-5:	*Abie to program 8085 microprocessor and 8051 microcontroller (Assembly Language Programming)*	2	80	70
CLO-6:	*Develop interfacing skills in 8085 microprocessor*	2	80	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	PSO - 1	PSO - 2	PSO - 3
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	M	M	H	M	H	H	H	M	H	M	H	M	M	M
H	M	H	H	H	H	H	M	H	H	H	H	H	H	H
M	H	H	M	H	H	H	H	M	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H

DURATION (HOURS)		12	12	12	12	12
S1 to S4	SLO-1 / SLO-2	*Introduction to Assembly Language Programming*	*Perform Block transfer of data from one set of memory locations to another set of memory location using 8085 microprocessor*	*Decimal counter using microprocessor 8085.*	*Perform Block transfer of data from one set of memory locations to another set of memory location using 8051 microcontroller.*	*Decimal counter using microcontroller 8051.*
S5 to S8	SLO-1 / SLO-2	*Perform the Arithmetic operations (addition and Subtraction) using microprocessor 8085.*	*Code conversion using microprocessor 8085.*	*Perform the Arithmetic operations (addition and Subtraction) using microcontroller 8051.*	*Code conversion using microcontroller 8051.*	*Interface LED with microprocessor 8085 using 8255 Programmable Peripheral Interface (PPI) and perform flashing.*
S9 to S12	SLO-1 / SLO-2	*Perform the Arithmetic operations (multiplication and division) using microprocessor 8085.*	*Temperature conversion using microprocessor 8085.*	*Perform the Arithmetic operations (multiplication and division) using microcontroller 8051.*	*Temperature conversion using microcontroller 8051.*	*Repeat/Revision of experiment*

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	UES20AE1T	Course Name	Environmental Studies	Course Category	AE	Ability Enhancement Courses	L	T	P	C
							3	0	0	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:*
CLR-1 :	*To teach the importance of environment*
CLR-2 :	*To impart the knowledge about ecosystem*
CLR-3 :	*To teach about Biodiversity*
CLR-4 :	*To create awareness about environmental pollution*
CLR-5 :	*To understand about Environment Protection*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			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 :	*To gain knowledge on the importance of natural resources and energy*	2	75	60	H	H	H	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*To understand the structure and function of an ecosystem*	2	80	70	-	H	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*To imbibe an aesthetic value with respect to biodiversity, understand the threats and its conservation and appreciate the concept of interdependence*	2	70	65	H	-	-		-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*To understand the causes of types of pollution and disaster management*	2	70	70	H	-	H	H	H	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*To observe and discover the surrounding environment through field work*	2	80	70	-	H	-	H	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Environmental Studies- Concept*	*Concept of an ecosystem*	*Biodiversity at Global, National And Local Levels*	*Causes, Effects and Control Measures of Nuclear hazards*	*Need for equitable utilization*
	SLO-2	*Scope and Importance of Environmental Studies*	*Ecosystem degradation and Resource utilization*	*India as a Mega Diversity Nation*		*Equity – Disparity*
S-2	SLO-1	*Need for public awareness.*	*Structure and Functions of an ecosystem*	*Threats to biodiversity: habitat loss, poaching of wildlife*	*Solid Waste Management Causes, Effects and Control Measures of Urban and Industrial Waste*	*Urban – rural equity issues*
	SLO-2	*Institutions in Environment*	*Producers, consumers and decomposers*	*man-wildlife conflicts*		*The need for Gender Equity*
S-3	SLO-1	*People in Environment*	*Energy flow in the ecosystem*	*Endangered species of India*	*Role of Individuals In Pollution Prevention*	*Preserving resources for future generations*
	SLO-2	*Awareness about Environmental Studies*	*The water cycle , The Carbon cycle , The Oxygen cycle , The Nitrogen cycle , The energy cycle and, Integration of cycles in nature*	*Endemic species of India*		*The rights of animals*
S-4	SLO-1	*Introduction to natural resources- Associated Problems*	*Ecological succession*	*Environmental Pollution- Definition*	*Disaster management- Nature Floods, Earthquakes*	*The ethical basis of environment education and awareness*
	SLO-2	*Renewable and Nonrenewable resources*	*Food chains, Food webs and Ecological pyramids*			
S-5	SLO-1	*Forest resources*	*Ecosystem, Introduction, Types, Characteristic features, Structure and functions*	*Causes, Effects and Control Measures of Air Pollution*	*Cyclones Landslides*	*The conservation ethic and traditional value systems of India*
	SLO-2	*Water Resources*	*Forest ecosystem*			
S-6	SLO-1	*Mineral Resources*	*Grassland ecosystem*	*Causes, Effects and Control Measures of Water Pollution*	*Social Issues and the Environment*	*Wasteland Reclamation*
	SLO-2	*Food Resources*	*Desert ecosystem*			

					From Unsustainable to Sustainable Development	
S-7	**SLO-1**	*Energy Resources*	*Aquatic ecosystems (ponds, lakes, streams)*	*Causes, Effects and Control Measures of Soil Pollution*	*WaterConservation*	*Climate change & Global warming*
	SLO-2	*Land Resources*	*Aquatic ecosystems (rivers, estuaries, oceans)*			
S-8	**SLO-1**	*Renewable and non-renewable resources- Wind*	*Value Of Biodiversity*	*Causes, Effects and Control Measures of Marine pollution*	*Rain Water Harvesting Watershed*	*Acid rain & Ozone layer depletion*
	SLO-2	*Renewable and non-renewable resources- geothermal*	*Consumptive Value And Productive Value*			
S-9	**SLO-1**	*Renewable and non-renewable resources- Solar*	*Social Value and Ethical Value*	*Causes, Effects and Control Measures of Noise Pollution*	*Environmental Ethics: Issues and Possible Solutions*	*Nuclear Accidents and Nuclear Holocaust*
	SLO-2	*Renewable and non-renewable resources- Biomass*	*Aesthetic Value and Option Value*	*Causes, Effects and Control Measures of Thermal Pollution*	*Resource consumption patterns*	

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

Learning Assessment

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
Mr. Suresh S, Program Head, Hello FM	*Dr. G Balasubramania Raja, Prof & Head, Manonmaniam Sundranar Universit, Mail-gbs_raja@yahoo.com*	*Dr. Rajesh R, Head, SRM IST*
		Dr.S.Albert Antony Raj, Associate Professor and Head, SRMIST

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Course Code	UJK20501T	Course Name	Leadership and Management Skills	Course Category	JK	*Life Skill Courses*	L	T	P	C
							2	0	0	2

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	**Learning**		
CLR-1 :	*help students to develop essential skills to influence and motivate others*	1	2	3
CLR-2 :	*Inculcate emotional and social intelligence and integrative thinking for effective leadership*			
CLR-3 :	*create and maintain an effective and motivated team to work for the society*			
CLR-4 :	*nurture a creative and entrepreneurial mindset*			
CLR-5 :	*make students understand the personal values and apply ethical principles in professional and social contexts*			
CLR-6 :	*manage competency-mix at all levels for achieving excellence with ethics*			

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 :	*examine various leadership models and understand / assess their skills, strengths and abilities that affect their own leadership style and can create their leadership vision*	*3*	*80*	*75*
CLO-2 :	*learn and demonstrate a set of practical skills such as time management, self-management, handling conflicts, team leadership, etc*	*3*	*80*	*75*
CLO-3 :	*understand the basics of entrepreneurship and develop business plan*	*3*	*75*	*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	ICT Skills	Professional Behavior	Life Long Learning
L	*M*	*H*	-	*M*	*M*	-	-	-	*M*	*H*	*L*	-	*H*	*H*
L	*M*	*H*	-	*M*	*M*	-	-	-	*M*	*H*	*L*	-	*H*	*H*
L	*M*	*H*	-	*M*	*M*	-	-	-	*M*	*H*	*L*	-	*H*	*H*

CLO-4 :	*apply the design thinking approach for leadership*	*3*	*75*	*70*	*L*	*M*	*H*	-	*M*	*M*	-	-	-	*M*	*H*	*L*	-	*H*	*H*
CLO-5 :	*appreciate the importance of ethics and moral values for making of a balanced personality*	*3*	*75*	*70*	*L*	*H*	*H*	-	*M*	*M*	-	-	-	*M*	*H*	*L*	-	*H*	*H*
CLO-6 :	*be an integral human being*	*3*	*75*	*70*	*L*	*H*	*H*	-	*M*	*M*	-	-	-	*M*	*H*	*L*	-	*H*	*H*

Duration (hour)		**6**	**6**	**6**	**6**	**6**
S-1	SLO-1	Leadership - definition	Team building	Management – definition	*Women in management*	*Entrepreneurship*
	SLO-2	Leadership – qualities	Team dynamics	Manager – traits	*Global gender perspective in business. Do women make good managers? - discussion*	*Entrepreneurship*
S-2	SLO-1	Leadership – styles	Work delegation	Scheduling work	*Confronting problems faced by women managers – case study*	*Successful Indian entrepreneurs – case study*
	SLO-2	Leadership – styles	Work delegation – activity	Scheduling work – activity	*Confronting problems faced by women managers – case study*	*Successful Indian entrepreneurs – case study*
S-3	SLO-1	*Difference between leader and boss*	Decision making	*Strategic planning*	*Successful women managers – documentary screening*	*Successful women entrepreneurs – case study*
	SLO-2	*Case study (based on leadership styles)*	Decision making - activity	*Strategic planning*	*Successful women managers – documentary screening*	*Successful women entrepreneurs – case study*
S-4	SLO-1	*Case study (based on leadership styles)*	Motivation	Change management	*Women labour force in work place*	*Ethics – definition*
	SLO-2	*Case study (based on leadership styles)*	Motivating for results	Change management – activity	*Problems faced by women labour force in work place - case study*	*Corporate ethics*
S-5	SLO-1	Leadership in diverse organizational structures, cultures and communications	Argumentation, Persuasion	*Energy management*	Sexual harassment of women at workplace (prevention, prohibition, and redressal) Act, 2013	*Essential elements of business ethics*
	SLO-2	Leadership in diverse organizational structures, cultures and communications	Negotiation , Networking	*Novel ways to manage energy in work place – activity*	Documentary screening - Sexual harassment of women at workplace	*Activity (students formulate ethical code of their business organization)*
S-6	SLO-1	Leading the organisation through stability and turbulence	Budget planning	*Work force management*	Transgender persons protection of rights act, 2019	*Ethical dilemma*
	SLO-2	Case study	Taking risk	*Grievance redressal policy in organisations*	Documentary screening –based on inclusiveness of the third gender in workplace	*Ethical dilemma - case study*

Learning Resources

1. *Craig E Johnson, Meeting the ethical challenges of leadership, Sage publications, 2018*
2. *Allan R Cohen, David L Bradford, Influence without authority, Wiley, 2018*
3. *T V Rao, Managers who make a difference: Sharpening your management skill, Random house India, 2016*
4. *Alexander Osterwalder, Business Model Generation,Wiley, 2013*
5. *Deborah Tannen, Talking from nine to five: Women and men in the workplace, Harper Collins publishers, 2010*
6. *Amish Tandon, Law of sexual harassment at workplace: Practice and procedure,Niyogi books, 2017*
7. *Rashmi Bansal, Connect the dots, Westland books, 2012*

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%	15%
	Understand				
Level 2	Apply	50%	50%	40%	50%
	Analyze				
Level 3	Evaluate	40%	40%	30%	35%
	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**
Ajay Zener, Director, Career Launcher	-	*Ms Sindhu Thomas B, Assistant Professor & Head in Charge, CDC, FSH, SRMIST*
		Mr Rajsekar, Assistant Professor, CDC, FOM, SRMIST

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Course Code	UPY20601T	Course Name	Atomic Physics and Spectroscopy	Course Category	C	Core Course	L	T	P	C
							4	2	0	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		
		1	2	3
CLR-1:	*Acquire knowledge Atomic Structure*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2:	*Acquire in depth knowledge of Atomic Structure in magnetic field*			
CLR-3:	*Understand the theory of X-ray Spectroscopy*			
CLR-4:	*Gain Knowledge about Molecular Spectra*			
CLR-5:	*Understanding of Raman Spectroscopy*			
CLR-6:	*Acquire knowledge of Laser Spectroscopy*			

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 skills to solve advance problems of Atomic structure*	2	80	75
CLO-2:	*Analyze the effect of magnetic field in Atomic structure*	2	80	70
CLO-3:	*Apply X-ray and Gamma ray spectroscopy for characterization of materials*	2	75	70
CLO-4:	*Apply molecular spectroscopy to determine the molecular vibrational properties*	2	80	75
CLO-5:	*Apply skills acquire to solve structural properties using Raman Spectroscopy*	2	80	70
CLO-6:	*Apply Acquire knowledge of Laser Spectroscopy to solve problems related to optical properties*	2	80	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	PSO - 1	PSO - 2	PSO - 3
CLO-1:	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-2:	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-3:	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-4:	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-5:	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-6:	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H

Duration (hour)		18	18	18	18	18
S-1	SLO-1	Early models of the atom	Magnetic dipole moment due to orbital motion	Breadth of Spectral Lines	Characterization of electromagnetic radiation	Raman scattering vs Rayleigh scattering
	SLO-2	Thomson and Rutherford models	Magnetic dipole in uniform magnetic field	Types of line spectra, Nomenclature and Line broadenings	Quantization of electromagnetic energy	Quantum theory of Raman effect
S-2	SLO-1	Rutherford's experiment	Electron spin/ quantum numbers *s* and m_s.	Effect of Nuclear Properties on Spectral Lines,	Regions of the electromagnetic spectrum	Classical theory of Raman effect
	SLO-2	Bohr's model of the atom	Stern-Gerlach experiment	Gamma Ray spectroscopy	Mechanism for interaction between radiation and matter	Rule for Raman activity
S-3	SLO-1	Bohr model of atom	Normal Zeeman effect	X-ray Spectra	Width of spectral lines	Polarizability ellipsoids of molecules
	SLO-2	Atomic spectra	Energy level diagram for Zeeman effect with and without spin	Characteristic of X-ray Spectroscopy	Energy-time uncertainty relation	Rotational Raman spectra of linear molecules
S-4	SLO-1	Spectral series and energy levels of hydrogen atom	Total angular momentum	Moseley's law	Intensity of spectral lines	Rotational Raman spectra of symmetric top molecules
	SLO-2	Rydberg Formula and Hydrogen atom series	Condition for quantum number j and m_j	Derivation and justification from the Bohr model of the Rutherford nuclear atom and its applications	Beer-Lambert law	Rotational Raman spectra of spherical top molecules
S-5	SLO-1	Problems solving on Bohr Model	Problem solving on Magnetic dipole in uniform magnetic field	Landau interval rule related problems	Problem solving on applicability of microwave or IR spectroscopy to molecules	Problem solving on selection rules for Raman scattering
	SLO-2	Problem solving on Atomic Spectra	Problem solving on Magnetic dipole in uniform magnetic field	Numerical problem solving on Gamma Ray spectroscopy	Problem solving on conversion of spectroscopic quantities	Problem solving on rotational spectrum of hydrogen molecule
S-6	SLO-1	Problems to find frequency, wavelength and energy of emitted during electron transition	Problem solving on Normal Zeeman effect	Problem solving on Energy splitting of levels	Problem solving on population distribution	Problem solving on applicability of IR or Raman spectroscopy to different molecular groups
	SLO-2	Derivation of the relation frequency, wavelength and energy	Problem solving on Normal Zeeman effect	Problem solving on Relative Energy scale	Problem solving on Beer-Lambert law	Problem solving on IR and Raman absorptions of A2B2 molecule
S-7	SLO-1	General discussion on Hydrogen spectra	Spin-orbit interaction	Absorption of X–rays	Microwave spectroscopy - Rotation of molecules - classification	Vibrational Raman spectra – Raman activity of vibrations
	SLO-2	Origin of Hydrogen Spectra	Spin-orbit interaction energy	Background and Applications	Rotational spectra of rigid diatomic molecule	Polarizability ellipsoid changes during vibration
S-8	SLO-1	Hydrogen spectral Series	Relativistic effects	Regular Doublet Law	Selection rules and allowed transitions between rotational energy levels	Rule of mutual exclusion
	SLO-2	Discussion on Hydrogen spectral series	Fine structure constant	Origin of Doublets	Intensities of spectral lines of rigid diatomic molecule	Overtone and combination frequencies
S-9	SLO-1	Hydrogen-like systems	Identical particles in relation multielectron atoms	Irregular Doublet Law	Expression for J quantum number with max. population	Structure of vibrational Raman spectrum

	SLO-2	He+ and Li2+	Indistinguishability in quantum mechanics	Origins of Irregular doublets and difference between regular and irregular doublets	Effect of isotopic substitution	Raman spectrum of choloroform
S-10	SLO-1	Spectra of monovalent atoms	Pauli's exclusion Principle	Photoelectron Spectra	Non-rigid rotator	Rotational fine structure
	SLO-2	Longest and shortest wavelengths possible for different spectral series of hydrogen atom	Slater determinants	Origin of Photoelectron Spectra	Spectrum of a non-rigid rotator	Some molecular data determined by Raman spectroscopy
S-11	SLO-1	Calculations of Longest and shortest wavelengths possible for different spectral series of hydrogen atom	Problem solving Spin-orbit interaction	Mosley's law related problems	Problem solving on microwave active molecules	Problem solving on selection rules for Raman scattering
	SLO-2	Problem solving on Spectra of monovalent atoms	Problem solving Spin-orbit interaction	Numerical problem solving on Photoelectron Spectra	Problem solving on rigid rotator	Problem solving on rotational spectrum of hydrogen molecule
S-12	SLO-1	Problem solving: Spectra of monovalent atoms	Problem Solving on Spin-orbit interaction	Doublet law related problems	Problem solving on rotational spectrum of HCl	Problem solving on applicability of IR or Raman spectroscopy to different molecular groups
	SLO-2	Problem solving: Hydrogen spectral series	Problem Solving on Pauli's exclusion Principle	Numerical problem solving on Absorption of X–rays	Problem solving on HCl vibrational frequency calculation from microwave data	Problem solving on IR and Raman absorptions of A2B2 molecule
S-13	SLO-1	Bohr's correspondence principle	Fermions versus bosons	Compton Effect	Infrared spectroscopy – vibrating diatomic molecule	Spin resonance spectroscopy - Spin of nuclei and electrons
	SLO-2	Interpretation of Bohr's correspondence principle	Relation between spin and symmetry	Physical Interpretation of Compton Effect	Simple harmonic oscillator	Interaction between spin and magnetic field
S-14	SLO-1	Sommerfeld's model	Helium atom ground state	Derivation of expression for change in wavelength	Anharmonic oscillator	Population of energy levels
	SLO-2	Interpretation of Sommerfeld's theory	Helium atom low-lying excited states	Physical Interpretation	Fundamental absorption and first, second overtones	Larmor precession
S-15	SLO-1	Sommerfeld's relativistic theory	Periodic table	Experimental verification	Diatomic vibrating rotator	NMR spectroscopy – chemical shift
	SLO-2	The effect of relativity	Energy ordering of outerfilled subshells	Related experiments	Vibration rotation spectrum of CO	Indirect coupling between two nuclei – AX spectrum
S-16	SLO-1	Fine Structure of Hydrogen Atom	Spectroscopic notation	Theory of Auger effect.	Vibrations of polyatomic molecules	Electron spin resonance absorption and the g factor
	SLO-2	Selection rules	Electron configuration	Related experiments and physical interpretation	Normal modes of vibration	Electron-nucleus coupling – hyperfine interaction
S-17	SLO-1	Problem solving: Sommerfeld's relativistic theory	Problem solving: Helium atom low-lying excited states	Problem solving on Compton effect	Problem solving on vibration spectra of NO	Problem solving of nuclear spin quantum number
	SLO-2	Problem solving: Sommerfeld's relativistic theory	Problem solving: Helium atom low-lying excited states	Problem solving on Relativistic motion of electron	Problem solving on vibration spectra of OCS	Problem solving on Larmor frequency calculation
S-18	SLO-1	Problem Solving: Fine Structure of Hydrogen Atom	Problem solving: Electron configuration	Problem solving on Auger effect	Problem solving on vibration spectra of HCl	Problem solving on ESR spectrum
	SLO-2	Problem solving: Fine Structure of Hydrogen Atom	Problem solving: Electron configuration	Problem solving on de Broglie vs Compton Scale	Problem solving on calculation of normal modes for molecules	Problem solving on hyperfine splitting in ESR spectrum

Learning Resources	1. Physics of Atoms and Molecules by Bransden and C.J. Joachain, (Longman Group, 1983) 2. Molecular Structure and Spectroscopy, Aruldhas (PHIL, 2007) 3. Fundamentals of Molecular Spectroscopy by Banwell C N and McCash E M (Tata McGraw-Hill, 2008)	4. Atomic Physics, Christopher and J. Foot (Oxford University Press, 2005) 5. Concepts of Modern Physics by Beiser A, (6th Edition Mc–Graw Hill, 2009) 6. Modern Physics by Krane K S (Wiley, 2016)

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	30 %	-	30 %	-	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
Mr. R Seshadri, Titan Company Limited, seshadri@titan.co.in	Dr. Ranjit Kumar Nanda, IIT Madras, nandab@iitm.ac.in	Dr. Saurabh Ghosh, SRMIST
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Course Code	UPY20602T	Course Name	Nuclear Physics	Course Category	C	Core Course	L	T	P	C
							4	2	0	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:
CLR-1:	*Develop kills to describe and explain the properties of nuclei and derive them from various models of nuclear structure.*
CLR-2:	*Understand, explain and derive the various theoretical formulation of nuclear disintegration like α decay, β decay and gamma decays.*
CLR-3:	*Enhances kills to develop basic understanding of the interaction of various nuclear radiation with matter in low and high energy*
CLR-4:	*Explain nuclear fusion and fission reactions, and basic elements of a nuclear reactor*
CLR-5:	*Acquire ability to understand simple detector systems for nuclear radiation and various types of nuclear accelerators.*
CLR-6:	*Gain knowledge on the role of nuclear physics in astrophysics*

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)															
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	1 Fundamental Knowledge	2 Application of Concepts	3 Link with Related Disciplines	4 Procedural Knowledge	5 Skills in Specialization	6 Ability to Utilize Knowledge	7 Skills in Modeling	8 Analyze, Interpret Data	9 Investigative Skills	10 Problem Solving Skills	11 Communication Skills	12 Analytical Skills	13 PSO - 1	14 PSO - 2	15 PSO - 3
CLO-1:	*Understand general concepts of nuclei, nuclear forces and nuclear physics.*	2	80	75	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-2:	*Learn the ground state properties of a nucleus – the constituents and their properties*	2	80	70	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
CLO-3:	*Know about the nuclear models and their roles in explaining the ground state properties of the nucleus*	2	75	70	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
CLO-4:	*Learn about the process of radioactivity, the radioactive decay law, the emission of alpha, beta, gamma decays/reactions and their role in nuclear energy and star formation.*	2	80	75	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
CLO-5:	*Understand nuclear fission and fusion processes and their safer use.*																		
CLO-6:	*Attain basic knowledge about nuclear radiation types, accelerators, and radiation detectors.*	2	80	70	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H

Duration (hour)		18	18	18	18	18
S-1	SLO-1	Importance of Nuclear Physics	Liquid drop model approach	Laws of Disintegration	Charged particle interaction with matter	Detectors: Introduction
	SLO-2	Overview of the Nuclear Physics syllabus and rationale and outcomes	Principles and hypothesis	Half life and average life period	Energy loss of electrons	Applications
S-2	SLO-1	Nucleus and its constituents	Semi empirical mass formula	Alpha decay	Gamma ray interaction with matter	Gas Filled Detectors
	SLO-2	Properties of Nucleus	Significance of its various terms in liquid drop model	Basics of alpha decay processes	Cerenkov radiation	Construction, working and application
S-3	SLO-1	Quantitative facts about mass, radii and charge density	Nuclear stability	Theory of alpha emission	Photoelectric effect (PE)	Ionization Chambers
	SLO-2	Nucleus charge density	Condition of nuclear stability	Gamow factor	Quantum Efficiency	Construction, working and application
S-4	SLO-1	Binding Energy	Energy , Momentum and Hamiltonian Operators	Geiger Nuttall law	Compton scattering (CS)	Scintillation Counters: PMTs
	SLO-2	Defect mass	Schrodinger's equation: Operator form	Alpha decay spectroscopy	Back scattering and Recoil Energy	Construction, working and application
S-5	SLO-1	Problem solving: Charge density	Problem solving: Liquid drop model-1	Problem solving: Radioactivity	Problem solving: Photoelectric effect	Problem solving: Nuclear Fusion-1
	SLO-2	Problem solving: Nucleus Radii	Problem solving: Liquid drop model-2	Discussion and Interaction: alpha decay	Problem solving: photoelectric effect	Problem solving: Nuclear Fusion-2
S-6	SLO-1	Problem solving: Binding Energy	Problem solving: Nuclear stability-1	Problem solving: Geiger Nuttal law	Problem solving: Compton effect	Problem solving: Nuclear Fission-1
	SLO-2	Problem solving: Defect mass	Problem solving: Nuclear stability 2	Discussion and Interaction: alpha decay spectroscopy	Problem solving: Compton effect	Problem solving: Nuclear Fission-2
S-7	SLO-1	Binding energy variation with mass number	Evidence for nuclear shell structure	Beta decay	Pair production	Geiger Muller Counter
	SLO-2	Salient features of Binding energy versus mass number curve	Shell Model: Assumptions	Energy kinematics for beta decay	Cross-sections of PE/CS/PP	Construction, working and application
S-8	SLO-1	Z/A plot	Shell Model: Square well potential	Positron emission	Neutron interaction with matter detectors	Semiconductor Detectors
	SLO-2	Isotopes and Abundance	Shell Model: H O potential	Electron capture	Slow Neutrons	Construction, working and application
S-9	SLO-1	Nuclear Angular momentum	Nuclear magic numbers	Beta Decay Spectrum	Nuclear Fission and Fusion Reactions	Cloud Chamber
	SLO-2	Nuclear Charge and Angular momentum	Shell Model: Spin Orbit Term	Neutrino hypothesis	Chain Reactions	Bubble Chamber
S-10	SLO-1	Concepts of Nucleus spin	Success of Shell model	Properties neutrinos and anti-neutrinos	Nuclear Reactor	Cherenkov Counters
	SLO-2	Angular momentum and Parity	Drawbacks of Nuclear Shell model	Detection of neutrinos	Control and Production	Their Advantages

S-11	SLO-1	Problem solving: electric moments	Problem solving: Symmetry-1	Reactions: beta decay	Problem solving: GM counter-1	Problem solving: Detector efficiency
	SLO-2	Problem solving: Magnetic moments	Problem solving: Symmetry-2	Reactions: Beta decay	Problem solving: GM counter -2	Problem solving: Detector resolution
S-12	SLO-1	Problem solving: Spin and Parity	Problem solving: Shell model -1	Reactions: Gamma decay-1	Problem solving: PMT-1	Problem solving: Detector working
	SLO-2	Problem solving: Nuclear excited states and energy levels	Problem solving: Shell model -2	Reactions: Gamma decay-2	Problem solving: PMT-2	Problem solving: Detector applications
S-13	SLO-1	Magnetic Dipole moment	Bulk Nucleus Deformation	Gamma Decays: X-ray vs Gamma-ray	Van-de-Graaff's Generator	The Sun
	SLO-2	Electric Quadrupole Moment	Collective Model: Introduction	Internal Conversion	Construction, working and application	Hydrogen Burning
S-14	SLO-1	Qualitative overview: Charge independence of Nuclear Forces	Collective Model: Collective Vibrations	Internal Pair Creation	Linear Accelerators	Solar Reactions
	SLO-2	Spin Dependence of of Nuclear Forces	Qualitative understanding	Coefficients of conversions	Construction and working application	Solar Neutrinos
S-15	SLO-1	Properties of Nuclear Forces	Collective Model: Collective Rotations	Artificial Radioactivity	Cyclotron	Stellar Evolution
	SLO-2	Yukawa Theory: Qualitative facts	Qualitative Understanding	Applications of radioactivity: Medicine, Agriculture,	Construction, working and application	Hydrogen to Silicon
S-16	SLO-1	Mass Spectrometer	Reconciliations of Models	Applications of radioactivity: Energy	Synchrotron	Silicon Burning
	SLO-2	Principle and Working	Future Prospective	Carbon dating, Radioactive tracers	Construction, working and application	Supernovae
S-17	SLO-1	Problem solving: electric moment	Discussion and Interaction: Collective model-1	Problem solving: conservation laws	Problem solving: Semiconductor detector-1	Problem solving: Hydrogen burning
	SLO-2	Problem solving: quadratic moment	Discussion and Interaction: Collective model-2	Problem solving: Q-value	Problem solving: Semiconductor detector-2	Problem solving: Star evolution
S-18	SLO-1	Problem solving: nuclear binging force-1	Discussion and Interaction: Mesonic field-1	Problem solving: reactions-1	Problem solving: Cyclotron	Problem solving: Neutrinos
	SLO-2	Problem solving: nuclear binding force-2	Discussion and Interaction: Mesonic field-2	Problem solving: reactions-2	Problem solving: Synchrotron	Problem solving: Supernovae

Learning Resources

1. Introductory Nuclear Physics, Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
2. Introduction to Nuclear and Particle Physics, VK Mittal, RC Verma, SC Gupta, (PHIL, 2013)
3. An Introduction to Nuclear Physics, W. N. Cottingham, D. A. Greenwood, Derek A. Greenwood (Cambridge University Press, 2001)
4. Nuclear Physics, Ghoshal S.N. (S. Chand Limited, 2008)
5. Basic ideas and concepts in Nuclear Physics - An Introductory Approach, K. Heyde (IOPInstitute)
6. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 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 / 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
Dr. M Satish, CSIR-CECRI, msathish@cecri.re.in	Prof. C Venkateshwaran, University of Madras, venkateshwaran@unom.ac.in	Dr. Eswaraiah, SRMIST
Dr. VJayaraman, IGCAR, Kalpakkam, vjram@igcar.gov.in	Prof. K Sethupathi, IIT Madras, *ksethu@iitm.ac.in*	Dr. RohitDhir, SRMIST

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Course Code	UPY20D10L	Course Name	Project Work	Course Category	G	Discipline Specific Elective Course	L	T	P	C
							0	0	12	6

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

Learning Assessment

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

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ALLIED

Course Code	UPY20A01J	Course Name	Allied Physics	Course Category	G	Generic Elective Course	L	T	P	C
							4	0	4	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:
CLR-1:	*Understand the fundamentals of physics*
CLR-2:	*Evaluate and learn the structural, optical, nuclear and electronic properties of solids*
CLR-3:	*Emphasize the significance of green technology and its applications*
CLR-4:	*Gain comprehensive knowledge and sound understanding of fundamentals of light and material properties*
CLR-5:	*Recognize how and when physics methods and principles can help address problems in their major*
CLR-6:	*Develop skills on practical, analytical problem solving in physics*

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 :	*Understand and solve problems on fundamentals of physics*	*2*	*80*	*75*
CLO-2 :	*Acquire knowledge on materials properties*	*2*	*80*	*70*
CLO-3 :	*Correlate the acquired knowledge and use it for various applications*	*2*	*75*	*70*
CLO-4 :	*Familiarize themselves with interaction of light and matter*	*2*	*80*	*75*
CLO-6 :	*Apply physics methods and principles to solve problems in the majors.*	*2*	*80*	*75*
CLO-5 :	*Learn magnetic, electrical and optical properties of materials*	*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
H	H	H	H	H	H	H	H	H	H	M	H	H	H	H
H	M	M	H	M	H	H	H	M	H	M	H	M	M	M
H	M	H	H	H	H	H	M	H	H	H	H	H	H	H
M	H	H	M	H	H	H	H	H	H	M	H	H	H	H
H	H	H	H	H	M	H	H	M	H	M	H	H	H	H
H	H	H	H	H	M	H	H	M	H	M	H	H	H	H

Duration (hour)		24	24	24	24	24
S-1	SLO-1	Sources of conventional energy	Space lattice basis	Kinetic theory of gases	Electric charge - conservation of charge	Time period - amplitude - phase
	SLO-2	Need for non - conventional energy resources	Unit Cell, lattice parameters	Basic postulates	Permittivity	Wave nature of light
S-2	SLO-1	Solar energy and solar cells and its applications	Two dimensional and three dimensional Bravais lattices	Ideal gas laws	Coulomb's law	Huygens's principle
	SLO-2	calculating energy generation by a solar cell	The seven crystal systems	Numerical problem solving on Ideal gas laws	Numerical problem solving on Coulomb's law	Numerical problem solving on amplitude, phase
S-3	SLO-1	Bio mass energy	Cubic crystal system	Van Der Waal's equation of states	Electric field	Interference
	SLO-2	Generation and applications of bio mass energy	Crystal symmetry	Derivation of Van Der Waal's equation of states	Electric potential	Young's double slit experiment
S-4	SLO-1	Wind energy generation and applications	Reciprocal lattice and its importance	Pressure of an ideal gas	Gauss's law	Coherence
	SLO-2	Numerical evaluation of wind energy generation	Density and atomic packing fraction	Derivation of Pressure of an ideal gas	Applications of Gauss's law	Interference from thin films
S-5 to S-8	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-9	SLO-1	Nuclear energy - Atomic structure	Numerical on Density and atomic packing fraction	Laws of thermodynamics	Numerical problem solving on Gauss's law	Michelson's interferometer
	SLO-2	Alpha, beta and gamma radiation	Crystal directions and planes	Problem solving on laws of Thermodynamics	Conductors and dielectrics	Diffraction - Wave theory of light
S-10	SLO-1	Law of radioactive decay	Introduction to Miller indices	Entropy	Electric Current	Numerical problem on interference
	SLO-2	Example problems in radioactivity	Numerical on Miller indices	Calculating numerical on entropy change	Problem on dielectrics and conductors	Light and Optics
S-11	SLO-1	Decay constant	Interplanar distance	Change of entropy in reversible and irreversible processes	Ohm's law	Fermat's principle
	SLO-2	Half-life and mean life	Numerical on interplanar distance	Change of entropy in irreversible processes	Magnetic induction	Laws of reflection and refraction
S-12	SLO-1	Nuclear energy	Hexagonal closely packed (HCP) structure	Low temperature	Permeability and susceptibility	Total internal reflection
	SLO-2	Applications of nuclear energy	Derivation of HCP atomic packing fraction	Joule - Kelvin effect-introduction	Numerical problem solving on Permeability and susceptibility	Illustrations of total internal reflection
S-13-S16	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-17	SLO-1	Mass defect and binding energy	Numerical problem solving on HCP structure	J-K effect- theory	Magnetic field due to a current carrying conductor-Biot-Savart's law	Problem solving on total internal reflection
	SLO-2	Solving numerical based on binding energy and mass defect.	Diamond crystal structure	Applications of J-K effect	Numerical problem solving on Biot-Savart's law	Mirrors and lenses

S-18	**SLO-1**	Fission reaction	Derivation of APF for diamond structure	Liquefaction of gases	Ampere's circuital law	Lens makers formula
	SLO-2	Evaluating nuclear energy generation by fission reaction	Numerical problem solving on diamond structure	Linde's process	Faraday's law	Problem solving on Lens makers formula
S-19	**SLO-1**	Fusion reaction	X-ray diffraction	Nitrogen gas liquefaction	Basic Electronics	Defects of images
	SLO-2	Fusion energy cycles	Problem solving on X-ray diffraction	H, He gas liquefaction	P and N type semiconductors	Coma distortion
S-20	**SLO-1**	Biological effects of radiation	Single crystal diffraction	Adiabatic demagnetization- introduction	Junction Diode	Spherical aberration in lenses
	SLO-2	Numerical problems involving Nuclear energy	powder diffraction	Working principle of adiabatic demagnetization-	Characteristics of Junction Diode	Chromatic aberration in lenses
S-21 - 24	**SLO-1**	Hall effect- Hall coefficient determination	Revision class for experiments	Determination of specific heat capacity of the liquid by Joule's calorimeter method	Band gap determination using Post Office Box – Specific resistance	Revision class for experiments
	SLO-2					

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

Learning Assessment

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

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

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