Integrated M.Sc. Physics

(Five Year Programme)

Curriculum, Programme Structure and Course Contents

(Adapted from TANSCHE B.Sc. Physics syllabus for first three years)

(2023-2024 onwards)

DEPARTMENT OF PHYSICS

Manonmaniam Sundaranar University

Tirunelveli

INTEGRATED M.Sc. PHYSICS SYLLABUS (First Three Years)

Preamble

Physics is one of the basic and fundamental sciences. The curriculum for the undergraduate programme in Physics is revised as per the UGC guidelines on Learning Outcome based Course Framework. The learner-centric courses let the student progressively develop a deeper understanding of various aspects of physics.

The new curriculum offer courses in the core areas of mechanics, acoustics, optics and spectroscopy, electricity and magnetism, atomic and nuclear physics, solid state, electronics and other fields. The courses will train students with sound theoretical and experimental knowledge that suits the need of academics and industry. In addition to the theoretical course work, the students also learn physics laboratory methods for different branches of physics, specialized measurement techniques, analysis of observational data, including error estimation and etc. The students will have deeper understanding of laws of nature through the subjects like classical mechanics, quantum mechanics, statistical physics etc. The problem solving ability of students will be enhanced. The students can apply principles in physics to real life problems. The courses like integrated electronics and microprocessors will enhance the logical skills as well as employability skills. The numerical methods and mathematical physics provide analytical thinking and provide a better platform for higher level physics for research.

The restructured courses with well-defined objectives and learning outcomes provide guidance to prospective students in choosing the elective courses to broaden their skills not only in the field of physics but also in interdisciplinary areas. The elective modules of the framework offer students choice to gain knowledge and expertise in specialized domains of physics like astrophysics, medical physics, etc.

TANSCHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR UNDERGRADUATE EDUCATION	
Programme	**B.Sc., Physics**
Programme Code	
Duration	**3 years [UG]**
Programme Outcomes: (These are mere guidelines. Faculty can create POs based on their curriculum or adopt from UGC or the University for their Programme)	**PO1: Disciplinary knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate programme of study **PO2: Communication Skills:** Ability to express thoughts and ideas effectively in writing and orally communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully; read and write analytically and present complex information in a clear and concise manner to different groups. **PO3: Critical thinking:** Capability to apply the analytic thought to a body of knowledge; analyse and evaluate the proofs, arguments, claims, beliefs on the basis of empirical evidences; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach.

	PO4: Problem solving: Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations. **PO5: Analytical reasoning**: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints. **PO6: Research-related skills**: A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesising and articulating; Ability to recognise cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation **PO7: Cooperation/Team work:** Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team **PO8: Scientific reasoning**: Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective. **PO9: Reflective thinking**: Critical sensibility to lived experiences, with self-awareness and reflexivity of both self and society. **PO10 Information/digital literacy:** Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data. **PO 11 Self-directed learning**: Ability to work independently, identifies appropriate resources required for a project, and manages a project through to completion. **PO 12 Multicultural competence:** Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups. **PO 13: Moral and ethical awareness/reasoning**: Ability to embrace moral/ethical values in conducting one's life, formulates a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one's work, avoid unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability

	issues; and adopting objective, unbiased and truthful actions in all aspects of work. **PO 14: Leadership readiness/qualities:** Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way. **PO 15: Lifelong learning:** Ability to acquire knowledge and skills, including „learning how to learn", that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.
Programme Specific Outcomes: **(These are mere guidelines. Faculty can create POs based on their curriculum or adopt from UGC or University for their Programme)**	**PSO1: Placement:** To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, and beliefs and apply diverse frames of reference to decisions and actions. **PSO 2**: **Entrepreneur:** To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate start-ups and high potential organizations **PSO3**: **Research and Development:** Design and implement HR systems and practices grounded in research that complies with employment laws, leading the organization towards growth and development. **PSO4**: **Contribution to Business World:** To produce employable, ethical and innovative professionals to be able to sustain in the dynamic business world. **PSO 5**: **Contribution to the Society:** To contribute to the development of the society by collaborating with stakeholders for mutual benefit

Credit Distribution for UG Programmes

Sem I	Credit	H	Sem II	Credit	H	Sem III	Credit	H	Sem IV	Credit	H	Sem V	Credit	H	Sem VI	Credit	H
Part 1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	5.1 Core Course – \CC IX	4	5	6.1 Core Course – CC XIII	4	6
Part.2 English	3	6	Part..2 English	3	6	Part..2 English	3	6	Part..2 English	3	6	5.2 Core Course – CC X	4	5	6.2 Core Course – CC XIV	4	6
1.3 Core Course – CC I	5	5	2..3 Core Course – CC III	5	5	3.3 Core Course – CC V	5	5	4.3 Core Course – CC VII Core Industry Module	5	5	5. 3.Core Course CC -XI	4	5	6.3 Core Course – CC XV	4	6
1.4 Core Course – CC II	5	5	2.4 Core Course – CC IV	5	5	3.4 Core Course – CC VI	5	5	4.4 Core Course – CC VIII	5	5	5. 4.Core Course –/ Project with viva-voce CC -XII	4	5	6.4 Elective -VII Generic/ Discipline Specific	3	5
1.5 Elective I Generic/ Discipline Specific	3	4	2.5 Elective II Generic/ Discipline Specific	3	4	3.5 Elective III Generic/ Discipline Specific	3	4	4.5 Elective IV Generic/ Discipline Specific	3	3	5.5 Elective V Generic/ Discipline Specific	3	4	6.5 Elective VIII Generic/ Discipline Specific	3	5
1.6 Skill Enhancement Course SEC-1	2	2	2.6 Skill Enhancement Course SEC-2	2	2	3.6 Skill Enhancement Course SEC-4, (Entrepreneurial Skill)	1	1	4.6 Skill Enhancement Course SEC-6	2	2	5.6 Elective VI Generic/ Discipline Specific	3	4	6.6 Extension Activity	1	-
1.7 Skill Enhancement -(Foundation Course)	2	2	2.7 Skill Enhancement Course –SEC-3	2	2	3.7 Skill Enhancement Course SEC-5	2	2	4.7 Skill Enhancement Course SEC-7	2	2	5.7 Value Education	2	2	6.7 Professional Competency Skill	2	2
						3.8 E.V.S.	-	1	4.8 E.V.S	2	1	5.8 Summer Internship /Industrial Training	2				
	23	**30**		**23**	**30**		**22**	**30**		**25**	**30**		**26**	**30**		**21**	**30**
Total – 140 Credits																	

5 –Year Integrated Programme M.Sc., Physics Credit Distribution for first 3 years				
Part	**Details**	**No. of Papers**	**Total Credits**	**Part Credits**
Part-I	Language (3 Credits)	4	12	12
Part-II	English (3 Credits)	4	12	12
Part-III	Core Theory (5 Credits)	4	20	86
	Core Theory (4 Credits)	6	24	
	Core Practical (3 Credits)	6	18	
	Project (4 Credits)	1	4	
	Allied Theory (3 Credits)	4	12	
	Allied Practical (2 Credits)	4	8	
Part-IV	Foundation Course (2 Credits)	1	2	31
	Skills Enhancement Course (SEC) NME (2 Credits)	8	16	
	Elective Core (2 Credits)	4	8	
	Summer Internship (1 Credits)	1	1	
	EVS (2 Credit)	1	2	
	Value Education (2 Credits)	1	2	
Part-V	Extension Activity (NSS/NCC/YRC/Physical Education) (1 Credit)	1	1	1
		50	**142**	**142**

Consolidated Semester wise and Component wise Credit Distribution

Parts	Sem-I	Sem-II	Sem-III	Sem-IV	Sem-V	Sem-VI	Total Credits
Part-I	3	3	3	3	-	-	12
Part-II	3	3	3	3	-	-	12
Part-III	13	13	13	13	23	19	84
Part-IV	4	4	4	6	3	2	31
Part-V	-	-	-	-	-	1	1
Total	**23**	**23**	**23**	**25**	**26**	**22**	**142**

Credit Distribution for Integrated M.Sc., Physics Programme, Courses with Laboratory Hours for First Three Years

Part	List of Courses	Credit	Hours/week	CIA	ESE	Passing Minimum
First Semester						
Part-I	Language	3	4	25	75	50
Part-II	English	3	4	25	75	50
Part-III	Core Theory 1 – Properties of Matter and Acoustics	5	5	25	75	50
	Core Practical 1 – Properties of Matter	3	6*	25	75	50
	Allied Theory 1 – Allied Mathematics 1	3	3	25	75	50
	Allied Practical 1 – Allied Mathematics 1	2	4	25	75	50
Part-IV	SEC-1 (Choose one from the List of Skill Enhancement Course (Includes Entrepreneurial Based)	2	2	25	75	50
	Foundation Course	2	2	25	75	50
		23	**30**			
Second Semester						
Part-I	Language	3	4	25	75	50
Part-II	English	3	4	25	75	50
Part-III	Core Theory 2 – Heat, Thermodynamics and Statistical Physics	5	5	25	75	50
	Core Practical 2 – Heat and Sound	3	6	25	75	50
	Allied Theory 2 – Allied Mathematics 2	3	3	25	75	50
	Allied Practical 2 – Allied Mathematics 2	2	4	25	75	50
Part-IV	SEC-2 (Choose one from the List of Skill Enhancement Course (Includes Entrepreneurial Based)	2	2	25	75	50
	SEC-3 (choose one from the List of Skill Enhancement Course (Discipline / Subject Specific))	2	2	25	75	50
		23	**30**			
Third Semester						
Part-I	Language	3	4	25	75	50
Part-II	English	3	4	25	75	50
Part-III	Core Theory 3 –Mechanics	5	5	25	75	50
	Core Practical 3 – Oscillations, Waves and Electronics	3	6	25	75	50
	Allied Theory 1 – Allied Chemistry 1	3	3	25	75	50
	Allied Practical 1 – Allied Chemistry Practical 1	2	4	25	75	50
Part-IV	SEC-4 (Choose one from the List of Skill Enhancement Course (Includes Entrepreneurial Based)	2	2	25	75	50
	SEC-5 (choose one from the List of Skill Enhancement Course (Discipline / Subject Specific))	2	2	25	75	50
		23	**30**			
Fourth Semester						
Part-I	Language	3	4	25	75	50
Part-II	English	3	4	25	75	50
Part-III	Core Theory 4 – Optics and Laser Physics	5	5	25	75	50

	Core Practical 4 – Optics	3	5	25	75	50
	Allied Theory 2 – Allied Chemistry 2	3	3	25	75	50
	Allied Practical 2 – Allied Chemistry Practical 2	2	4	25	75	50
Part-IV	SEC-6 (choose one from the List of Skill Enhancement Course (Discipline / Subject Specific))	2	2	25	75	50
	SEC-7 (choose one from the List of Skill Enhancement Course (Discipline / Subject Specific))	2	2	25	75	50
	EVS	2	1	25	75	50
		25	**30**			
Fifth Semester						
Part -III	Core Theory 5 – Electricity, Magnetism and Electromagnetism	4	4	25	75	50
	Core Theory 6 – Atomic and Nuclear Physics	4	4	25	75	50
	Core Theory 7 – Analog and Communication Electronics	4	4	25	75	50
	Core Practical 5 – Electricity and Modern Physics	3	6	25	75	50
	Elective Course 1 (Generic/Discipline Specific) EC 1	2	2	25	75	50
	Elective Course 2 (Generic/Discipline Specific) EC 2	2	2	25	75	50
	Project with viva-voce	4	6	25	75	50
Part-IV	Internship / Industrial Training (Carried out in II Year Summer Vocation) (30 Hours)	1	-	25	75	50
	Value Education	2	2	25	75	50
		26	**30**			
Sixth Semester						
Part-III	Core Theory 8 – Quantum Mechanics and Relativity	4	4	25	75	50
	Core Theory 9 – Solid State Physics	4	4	25	75	50
	Core Theory 10 – Digital Electronics and Microprocessor 8085	4	4	25	75	50
	Core Practical 6 – Digital Electronics and Microprocessor	3	6	25	75	50
	Elective Course 3 (Generic/Subject Specific) EC 3	2	2	25	75	50
	Elective Course 4 (Generic/Subject Specific) EC 4	2	2	25	75	50
Part-IV	Skill Enhancement Course -SEC-8 (Discipline/Subject Specific) / Professional Competency	2	2	25	75	50
Part-V	Extension Activity, NSS/NCC/YRC/Physical Education (Outside College Hours)	1	-	25	75	50
		22	**24**			
		142				

*Both the theory and the practical End Semester Examination duration is 3 hours

LIST OF ELECTIVES COURSES (EC)

1. COMMUNICATION SYSTEMS
2. ENERGY PHYSICS
3. MATHEMATICAL PHYSICS
4. ADVANCED MATHEMATICAL PHYSICS
5. NUMERICAL METHODS AND C PROGRAMMING
6. MATERIALS SCIENCE

7. LASERS AND FIBER OPTICS
8. DIGITAL PHOTOGRAPHY
9. NANO SCIENCE
10. MEDICAL INSTRUMENTATION

LIST OF NON-MAJOR ELECTIVES (NME)

1. PHYSICS FOR EVERYDAY LIFE
2. ASTROPHYSICS
3. MEDICAL PHYSICS
4. HOME ELECTRICAL INSTALLATION
5. PHYSICS OF MUSIC

LIST OF SKILL ENHANCEMENT COURSE (INCLUDES ENTREPRENEURIAL BASED)

1. PLOTTING SKILLS
2. INTRODUCTION TO PYTHON PROGRAMMING
3. INTRODUCTION TO ANDROID MOBILE APPLICATION DEVELOPMENT
4. INTRODUCTION TO WEB DEVELOPMENT

LIST OF SKILL ENHANCEMENT COURSE (DISCIPLINE / SUBJECT SPECIFIC)

1. PHYSICS WORKSHOP SKILLS
2. ELECTRICAL CIRCUIT NETWORK SKILLS
3. BASIC INSTRUMENTATION SKILLS
4. WEATHER FORECASTING SKILLS
5. RENEWABLE ENERGY AND ENERGY HARVESTING
6. MATERIALS PROCESSING SKILLS

PASSING MINIMUM

Continuous Internal Assessment (CIA) – No passing minimum
End Semester Examination (ESE) – 50%
Cumulative Aggregate – 50%

ESE QUESTION PAPER PATTERN for Core theory courses

Part – A **10×1=10**	**Part- B Either (a) or (b)** **5×5=25**	**Part- C Either (a) or (b)** **5×8=40**
MCQ	Only problems covered in tutorials	Descriptive type

CIA QUESTION PAPER PATTERN for all theory courses

Part – A 7×1=7	**Part- B Any two of three 2×5=10**	**Part- C Any One of three** **1×8=8**
MCQ	Only problems covered in tutorials / Descriptive	Descriptive type

COURSE	**FIRST SEMESTER – FOUNDATION COURSE**
COURSE TITLE	**INTRODUCTORY PHYSICS**
CREDITS	2
COURSE OBJECTIVES	To help students get an overview of Physics before learning their core courses. To serve as a bridge between the school curriculum and the degree programme.

UNITS	**COURSE DETAILS**
UNIT-I	vectors, scalars –examples for scalars and vectors from physical quantities – addition, subtraction of vectors – resolution and resultant of vectors – units and dimensions– standard physics constants
UNIT-II	different types of forces–gravitational, electrostatic, magnetic, electromagnetic, nuclear –mechanical forces like, centripetal, centrifugal, friction, tension, cohesive, adhesive forces
UNIT-III	different forms of energy– conservation laws of momentum, energy – types of collisions –angular momentum– alternate energy sources– real life examples
UNIT-IV	types of motion– linear, projectile, circular, angular, simple harmonic motions – satellite motion – banking of a curved roads – stream line and turbulent motions – wave motion – comparison of light and sound waves – free, forced, damped oscillations
UNIT-V	surface tension – shape of liquid drop – angle of contact – viscosity –lubricants – capillary flow – diffusion – real life examples– properties and types of materials in daily use- conductors, insulators – thermal and electric
UNIT-VI	**PROFESSIONAL COMPONENTS:** expert lectures –seminars — webinars – industry inputs – social accountability – patriotism
TEXT BOOKS	1. D.S. Mathur, 2010, Elements of Properties of Matter, S.Chand and Co 2. BrijLaland N. Subrahmanyam, 2003, Properties of Matter, S.Chand and Co.
REFERENCE BOOKS	1. H.R. Gulati, 1977, Fundamental of General Properties of Matter, Fifth edition, S.Chand and Co.
WEB RESOURCES	1. http://hyperphysics.phy-astr.gsu.edu/hbase/permot2.htmlhttps://science.nasa.gov/ems/ 2. https://eesc.columbia.edu/courses/ees/climate/lectures/radiation_hays/

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

COURSEOUTCOMES:

At the end of the course, the student will be able to:

COURSEOUTCOMES	**CO1**	Apply concept of vectors to understand concepts of Physics and solve problems
	CO2	Appreciate different forces present in Nature while learning about phenomena related to these different forces.
	CO3	Quantify energy in different process and relate momentum, velocity and energy
	CO4	Differentiate different types of motions they would encounter in various courses and understand their basis
	CO5	Relate various properties of matter with their behaviour and connect them with different physical parameters involved.

MAPPINGWITHPROGRAMOUTCOMES:

Map course outcomes (CO) for each course with program outcomes (PO) in the 3-point scale of STRONG(3), MEDIUM(2) and LOW(1).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	3	3	2	3	2
CO2	2	3	3	3	2	3	3	2	2	2
CO3	3	3	3	2	3	3	3	2	3	2
CO4	3	3	3	3	3	3	3	2	2	2
CO5	3	2	3	3	3	3	3	2	2	3

COURSE	**FIRST SEMESTER – CORE THEORY 1**
COURSETITLE	**PROPERTIES OF MATTER AND ACOUSTICS**
CREDITS	5
COURSE OBJECTIVES	Study of the properties of matter leads to information which is of practical value to both the physicist and the engineers. It gives us information about the internal forces which act between the constituent parts of the substance. Students who undergo this course are successfully bound to get a better insight and understanding of the subject.

UNITS	COURSE DETAILS
UNIT-I	**ELASTICITY:** Hooke's law – stress-strain diagram – elastic constants –Poisson's ratio – relation between elastic constants and Poisson's ratio – work done in stretching and twisting a wire – twisting couple on a cylinder – rigidity modulus by static torsion– torsional pendulum (with and without masses)
UNIT-II	**BENDING OF BEAMS:** cantilever– expression for Bending moment – expression for depression at the loaded end of the cantilever– oscillations of a cantilever – expression for time period – experiment to find Young's modulus – non-uniform bending– experiment to determine Young's modulus by Koenig's method – uniform bending – expression for elevation – experiment to determine Young's modulus using microscope
UNIT-III	**FLUID DYNAMICS:** *Surface tension*: definition – molecular forces– excess pressure over curved surface – application to spherical and cylindrical drops and bubbles – determination of surface tension by Jaegar's method–variation of surface tension with temperature *Viscosity*: definition – streamline and turbulent flow – rate of flow of liquid in a capillary tube – Poiseuille's formula –corrections – terminal velocity and Stoke's formula– variation of viscosity with temperature
UNIT-IV	**WAVES AND OSCILLATIONS:** Simple Harmonic Motion (SHM) – differential equation of SHM – graphical representation of SHM – composition of two SHM in a straight line and at right angles – Lissajous's figures- free, damped, forced vibrations –resonance and Sharpness of resonance. Laws of transverse vibration in strings –sonometer – determination of AC frequency using sonometer–determination of frequency using Melde'sstring apparatus
UNIT-V	**ACOUSTICS OF BUILDINGS AND ULTRASONICS:** Intensity of sound – decibel – loudness of sound –reverberation – Sabine's reverberation formula – acoustic intensity – factors affecting the acoustics of buildings. *Ultrasonic waves*: production of ultrasonic waves – Piezoelectric crystal method –magnetostriction effect – application of ultrasonic waves

UNIT-VI	**PROFESSIONAL COMPONENTS:** expert lectures –seminars — webinars – industry inputs – social accountability – patriotism
TEXT BOOKS	1. D.S.Mathur, 2010, Elements of Properties of Matter, S.Chand and Co. 2. BrijLal and N. Subrahmanyam, 2003, Properties of Matter, S.Chand and Co 3. D.R.Khanna and R.S.Bedi, 1969, Textbook of Sound, Atma Ramand sons 4. BrijLal and N.Subrahmanyam, 1995, A Text Book of Sound, Second revised edition, Vikas Publishing House. 5. R.Murugesan,2012, Properties of Matter, S.Chand and Co.
REFERENCE BOOKS	1. C.J. Smith, 1960, General Properties of Matter, Orient Longman Publishers 2. H.R. Gulati, 1977, Fundamental of General Properties of Matter, Fifth edition,R. Chand and Co. 3. A.P French, 1973, Vibration and Waves, MIT Introductory Physics, Arnold-Heinmann India.
WEB RESOURCES	1. https://www.biolinscientific.com/blog/what-are-surfactants-and-how-do-they-work 2. http://hyperphysics.phy-astr.gsu.edu/hbase/permot2.html 3. https://www.youtube.com/watch?v=gT8Nth9NWPM 4. https://www.youtube.com/watch?v=m4u-SuaSu1sandt=3s 5. https://www.biolinscientific.com/blog/what-are-surfactants-and-how-do-they-work 6. https://learningtechnologyofficial.com/category/fluid-mechanics-lab/ 7. http://www.sound-physics.com/ 8. http://nptel.ac.in/courses/112104026/

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	75	100	

COURSE OUTCOMES:

At the end of the course, the student will be able to:

COURSEOUTCOMES	**CO1**	Relate elastic behavior in terms of three modulii of elasticity and working of torsion pendulum.
	CO2	Able to appreciate concept of bending of beams and analyze the expression, quantify and understand nature of materials.
	CO3	Explain the surface tension and viscosity of fluid and support the interesting phenomena associated with liquid surface, soap films provide an analogue solution to many engineering problems.
	CO4	Analyze simple harmonic motions mathematically and apply them. Understand the concept of resonance and use it to evaluate the frequency of vibration. Set up experiment to evaluate frequency of ac mains
	CO5	Understand the concept of acoustics, importance of constructing buildings with good acoustics. Able to apply their knowledge of ultrasonics in real life, especially in medical field and assimilate different methods of production of ultrasonic waves

MAPPING WITH PROGRAM OUT COMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the 3-point scale of STRONG(**S**), MEDIUM (**M**) and LOW(**L**).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	M	M	S	M	S
CO2	M	S	S	S	M	M	S	M	S	S
CO3	S	M	S	M	S	S	M	S	S	S
CO4	S	S	S	S	S	M	S	M	M	M
CO5	M	M	S	S	M	S	S	S	S	M

COURSE	**FIRST SEMESTER –CORE PRACTICAL 1**
COURSETITLE	**PROPERTIES OF MATTER**
CREDITS	3
COURSE OBJECTIVES	Apply various physics concepts to understand Properties of Matter, set up experimentation to verify theories, quantify and analyse, able to do error analysis and correlate results

Minimum of Fourteen Experiments from the list:

1. Determination of rigidity modulus without mass using Torsional pendulum.
2. Determination of rigidity modulus with masses using Torsional pendulum.
3. Determination of moment of inertia of an irregular body.
4. Verification of parallel axes theorem on moment of inertia.
5. Verification of perpendicular axes theorem on moment of inertia.
6. Determination of moment of inertia and g using Bifilar pendulum.
7. Determination of Young's modulus by stretching of wire with known masses.
8. Verification of Hook's law by stretching of wire method.
9. Determination of Young's modulus by uniform bending – load depression graph.
10. Determination of Young's modulus by non-uniform bending – scale and telescope.
11. Determination of Young's modulus by cantilever – load depression graph.
12. Determination of Young's modulus by cantilever – oscillation method
13. Determination of Young's modulus by Koenig's method – (or unknown load)
14. Determination of rigidity modulus by static torsion.
15. Determination of Y, n and K by Searle's double bar method.
16. Determination of surface tension and interfacial surface tension by drop weight method.
17. Determination of co-efficient of viscosity by Stokes' method – terminal velocity.
18. Determination of critical pressure for streamline flow.
19. Determination of Poisson's ratio of rubber tube.
20. Determination of viscosity by Poiseullie's flow method.
21. Determination radius of capillary tube by mercury pellet method.
22. Determination of g using compound pendulum.
23. Velocity of sound through wire using sonometer
24. To verify laws of transverse vibration using sonometer
25. To verify laws of transverse vibration using Melde's apparatus
26. Any other practicals

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

COURSE	SECOND SEMESTER – CORE THEORY 2
COURSETITLE	HEAT, THERMODYNAMICS and STATISTICAL PHYSICS
CREDITS	5
COURSE OBJECTIVES	The course focuses to understand a basic in conversion of temperature in Celsius, Kelvin and Fahrenheit scales. Practical exhibition and explanation of transmission of heat in good and bad conductor. Relate the laws of thermodynamics, entropy in everyday life and explore the knowledge of statistical mechanics and its relation

UNITS	COURSEDETAILS
UNIT-I	**CALORIMETRY:** specific heat capacity – specific heat capacity of gases C_P and C_V– Meyer's relation – Joly's method for determination of C_V – Regnault's method for determination of C_P **LOWTEMPERATUREPHYSICS:** Joule-Kelvin effect – porous plug experiment – Joule-Thomson effect –Boyle temperature – temperature of inversion – liquefaction of gas by Linde's Process – adiabatic demagnetisation.
UNIT-II	**THERMODYNAMICS-I:** zeroth law and first law of thermodynamics – P-V diagram – heat engine –efficiency of heat engine – Carnot's engine, construction, working and efficiency of petrol engine and diesel engines – comparison of engines.
UNIT-III	**THERMODYNAMICS-II:** second law of thermodynamics – entropy of an ideal gas – entropy change in reversible and irreversible processes – T-S diagram –thermodynamical scale of temperature – Maxwell's thermodynamical relations –Clasius-Clapeyron's equation (first latent heat equation) – third law of thermodynamics – unattainability of absolute zero – heat death.
UNIT-IV	**HEATTRANSFER:** modes of heat transfer: conduction, convection and radiation. *Conduction*: thermal conductivity – determination of thermal conductivity of a good conductor by Forbe's method – determination of thermal conductivity of a bad conductor by Lee's disc method. *Radiation*: black body radiation (Ferry's method) – distribution of energy in black body radiation – Wien's law and Rayleigh Jean's law –Planck's law of radiation – Stefan's law – deduction of Newton's law of cooling from Stefan's law.
UNIT-V	**STATISTICALMECHANICS:** definition of phase-space – micro and macro states – ensembles –different types of ensembles – classical and quantum Statistics – Maxwell-Boltzmann statistics – expression for distribution function – Bose-Einstein statistics – expression for distribution function – Fermi-Dirac statistics – expression for distribution function – comparison of three statistics.
UNIT-VI	**PROFESSIONAL COMPONENTS:** expert lectures –seminars – – webinars – industry inputs – social accountability – patriotism

TEXT BOOKS	1. Brijlal and N. Subramaniam, 2000, Heat and Thermodynamics, S.Chand and Co. 2. Narayanamoorthy and KrishnaRao, 1969, Heat, Triveni Publishers, Chennai. 3. V.R.Khanna and R.S.Bedi, 1998 1st Edition, Text book of Sound, Kedharnaath Publish and Co, Meerut 4. Brijlal and N. Subramanyam, 2001, Waves and Oscillations, Vikas Publishing House, New Delhi. 5. Ghosh, 1996, Text Book of Sound, S.Chand andCo. 6. R.Murugeshan and Kiruthiga Sivaprasath, Thermal Physics, S.Chandand Co.
REFERENCE BOOKS	1. J.B.Rajam and C.L.Arora, 1976, Heat and Thermodynamics, 8th edition, S.Chand and Co. Ltd. 2. D.S.Mathur, Heat and Thermodynamics, Sultan Chand and Sons. 3. Gupta, Kumar, Sharma, 2013, Statistical Mechanics, 26th Edition, S. Chand and Co. 4. Resnick, Halliday and Walker, 2010, Fundamentals of Physics, 6th Edition. 5. Sears, Zemansky, Hugh D. Young, Roger A. Freedman, 2021 University Physics with Modern Physics 15th Edition, Pearson.
WEB RESOURCES	1. https://youtu.be/M_5KYncYNyc 2. https://www.youtube.com/watch?v=4M72kQulGKkandvl=en 3. Lecture 1: Thermodynamics Part 1 | Video Lectures | Statistical Mechanics I: Statistical Mechanics of Particles | Physics | MIT OpenCourseWare 4. http://www.freebookcentre.net/Physics/Physics-Books-Online.html

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

COURSE OUTCOMES:
At the end of the course, the student will be able to:

COURSEOUTCOMES	**CO1**	Acquires knowledge on how to distinguish between temperature and heat. Introduce him/her to the field of thermometry and explain practical measurements of high temperature as well as low temperature physics. Student identifies the relationship between heat capacity, specific heat capacity. The study of Low temperature Physics sets the basis for the students to understand cryogenics, superconductivity, superfluidity and Condensed Matter Physics
	CO2	Derive the efficiency of Carnot's engine. Discuss the implications of the laws of Thermodynamics in diesel and petrol engines
	CO3	Able to analyze performance of thermodynamic systems viz efficiency by problems. Gets an insight into thermodynamic properties like enthalpy, entropy
	CO4	Study the process of thermal conductivity and apply it to good and bad conductors. Quantify different parameters related to heat, relate them with various physical parameters and analyse them
	CO5	Interpret classical statistics concepts such as phase space, ensemble, Maxwell-Boltzmann distribution law. Develop the statistical interpretation of Bose-Einstein and Fermi-Dirac . Apply to quantum particles such as photon and electron

MAPPING WITH PROGRAM OUT COMES:
Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the 3-point scale of STRONG(**S**), MEDIUM(**M**) and LOW(**L**).

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	S	S	M	S	M
CO2	M	S	S	S	M	S	S	M	M	M
CO3	S	S	S	M	S	S	S	M	S	M
CO4	S	S	S	S	S	S	S	M	M	M
CO5	S	S	M	S	S	S	M	M	S	M

COURSE	**SECOND SEMESTER – CORE PRACTICAL 2**
COURSETITLE	**HEAT AND SOUND**
CREDITS	3
COURSE OBJECTIVES	Apply their knowledge gained about the concept of heat and sound waves, resonance, calculate frequency of ac mains set up experimentation to verify theories, quantify and analyse, able to do error analysis and correlate results

Minimum of Fourteen Experiments from the list:

1. Determination of specific heat by cooling – graphical method.
2. Determination of thermal conductivity of good conductor by Searle's method.
3. Determination of thermal conductivity of bad conductor by Lee's disc method.
4. Determination of thermal conductivity of bad conductor by Charlaton's method.
5. Determination of specific heat capacity of solid.
6. Determination of specific heat of liquid by Joule's electrical heating method (applying radiation correction by Barton's correction/graphical method),
7. Determination of Latent heat of a vaporization of a liquid.
8. Determination of Stefan's constant for Black body radiation.
9. Verification of Stefan's-Boltzmans law.
10. Determination of thermal conductivity of rubber tube.
11. Helmholtz resonator.
12. Velocity of sound through a wire using Sonometer.
13. Determination of velocity of sound using Kunds tube.
14. Frequency of AC by using sonometer.
15. Newton's Law of cooling
16. Measurement of Planck's constant
17. To study the variation of thermo emf for thermometer with difference of Temperature of its junctions
18. Any other practicals

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

COURSE	**THIRD SEMESTER - CORE**
COURSETITLE	**MECHANICS**
CREDITS	5
COURSE OBJECTIVES	This course allows the students: To have a basic understanding of the laws and principles of mechanics; To apply the concepts of forces existing in the system; To understand the forces of physics in everyday life; To visualize conservation laws; To apply Lagrangian equation to solve complex problems.

UNITS	**COURSEDETAILS**
UNIT-I	**LAWS OF MOTION:** Newton's Laws – forces – equations of motion – frictional force – motion of aparticlein a uniform gravitational field – types of everyday forces in Physics. *Gravitation*: Classical theory of gravitation**–**Kepler's laws, Newton's law of gravitation – Determination of G by Boy's method – Earth-moon system – weightlessness – earth satellites – parking orbit – earth density – mass of the Sun – gravitational potential – velocity of escape – satellite potential and kinetic energy –Einstein's theory of gravitation – introduction –principle of equivalence – experimental tests of general theory of relativity – gravitational red shift – bending of light – perihelion of mercury.
UNIT-II	**CONSERVATION LAWS OF LINEAR AND ANGULAR MOMENTUM: c**onservation of linear and angular momentum – Internal forces and momentum conservation – center of mass – examples – general elastic collision of particles of different masses – system with variable mass – examples – conservation of angular momentum – torque due to internal forces – torque due to gravity – angular momentum about center of mass – proton scattering by heavy nucleus.
UNIT-III	**CONSERVATION LAWS OF ENERGY:** Introduction – significance of conservation laws – law of conservation of energy concepts of work- power – energy – conservative forces – potential energy and conservation of energy in gravitational and electric field – examples –non-conservative forces – general law of conservation of energy.
UNIT-IV	**RIGID BODY DYNAMICS: t**ranslational and rotational motion – angular momentum – moment of inertia – general theorems of moment of inertia – examples – rotation about fixed axis – kinetic energy of rotation – examples – body rolling along a plane surface – body rolling down an inclined plane – gyroscopic precision – gyrostatic applications.
UNIT-V	**LAGRANGIAN MECHANICS:** generalized coordinates – degrees of freedom – constraints - principle of virtual work and D' Alembert's Principle – Lagrange's equation from D' Alembert's principle – application –simple pendulum – Atwood's machine.
UNIT-VI	**PROFESSIONAL COMPONENTS:** expert lectures –seminars – – webinars – industry inputs – social accountability – patriotism

TEXT BOOKS	1. J.C.Upadhyaya, 2019, Classical Mechanics, Himalaya Publishing house, Mumbai. 2. P.Durai Pandian, Laxmi DuraiPandian, MuthamizhJayapragasam,2005, Mechanics, 6th revised edition, S.Chand and Co. 3. D. S.Mathur and P. S.Hemne, 2000, Mechanics, Revised Edition, S.Chand and Co. 4. Narayanamurthi, M.andNagarathnam. N, 1998, Dynamics. The National Publishing,Chennai. 5. Narayanamurthi, M. and Nagarathnam, N, 1982, Statics, Hydrostatics and Hydrodynamics, The National Publishers, Chennai.
REFERENCE BOOKS	1. Goldstein Herbert, 1980, Classical Mechanics. U.S.A: Addison and Wesely. 2. Halliday, David and Robert, Resnick, 1995, Physics Vol.I. New Age, International, Chennai. 3. Halliday, David Robert Resnick and Walker Jearl, 2001, Fundamentals of Physics, John Wiley, New Delhi
WEB RESOURCES	1. https://youtu.be/X4_K-XLUIB4 2. https://nptel.ac.in/courses/115103115 3. https://www.youtube.com/watch?v=p075LPq3Eas 4. https://www.youtube.com/watch?v=mH_pS6fruyg 5. https://onlinecourses.nptel.ac.in/noc22_me96/preview 6. https://www.youtube.com/watch?v=tdkFc88Fw-M 7. https://onlinecourses.nptel.ac.in/noc21_me70/preview

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

COURSE OUTCOMES:
At the end of the course, the student will be able to:

COURSEOUTCOMES	**CO1**	Understand the Newton's Law of motion, understand general theory of relativity, Kepler's laws and Realize the basic principles behind planetary motion
	CO2	Acquire the knowledge on the conservation laws
	CO3	Apply conservation law and calculate energy of various systems, understand and differentiate conservative and non-conservative forces
	CO4	Gain knowledge on rigid body dynamics and solve problems based on this concept
	CO5	Appreciate Lagrangian system of mechanics, apply D' Alemberts principle

MAPPING WITH PROGRAM OUT COMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the 3-point scale of STRONG(**S**), MEDIUM(**M**) and LOW(**L**).

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	M	S	S	S	M	S	S
CO2	S	S	S	M	S	M	S	S	S	M
CO3	S	S	S	S	S	S	M	S	M	S
CO4	M	S	S	S	M	S	S	M	S	S
CO5	S	S	M	S	S	M	S	S	S	M

COURSE	**THIRD SEMESTER - COREPRACTICAL 3**
COURSETITLE	**OSCILLATIONS, WAVES AND ELECTRONICS**
CREDITS	3
COURSE OBJECTIVES	Construct experiments simple harmonic motion, sound waves and study the characteristics of discrete components such diode, transistort

Minimum of Fourteen Experiments from the list:

1. Simple pendulum
2. Compound pendulum
3. Bifilar Pendulum
4. Determination of frequency of an electrically maintained tuning fork
5. To verify the laws of transverse vibration using sonometer.
6. To verify the laws of transverse vibration using Melde's apparatus.
7. To compare the mass per unit length of two strings using Melde's apparatus.
8. PN diode characteristics
9. Zener Diode characteristics
10. Construction of Full wave bridge rectifier with capacitor
11. Construction of Dual Power supply
12. Low pass filter and high pass filter
13. CE mode transistor characteristics
14. CB mode transistor characteristics
15. CC mode transistor characteristics
16. RC coupled CE transistor amplifier - single stage.
15. Clipping and clamping circuits
16. Any other practicals

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

COURSE	**FOURTH SEMESTER – CORE THEORY 4**
COURSETITLE	**OPTICS and LASER PHYSICS**
CREDITS	5
COURSE OBJECTIVES	To provide an in-depth understanding of the basics of various phenomena in geometrical and wave optics; To explain the behaviour of light in different mediums; To understand the differences in the important phenomena namely interference, diffraction and Polarization and apply the knowledge in day to day life; To understand the design of optical systems and methods to minims aberrations; To understand the working and applications of laser

UNITS	COURSEDETAILS
UNIT-I	**LENS AND PRISMS:** Fermat's principle of least time – postulates of geometrical optics – thick and thin lenses – focal length, critical thickness, power and cardinal points of a thick lens – narrow angled prisms. *Lens*: aberrations: spherical aberration, chromatic aberrations, coma, and astigmatism– curvature of the field – distortion – chromatic aberrations methods. *Prism*: dispersion, deviation, aberrations - applications rainbows and halos, constant deviation spectroscope. *Eyepieces*: advantage of an eyepiece over a simple lens – Huygen's and Ramsden's eyepieces, construction and working –merits and demerits of the eyepiece. *Resolving power*: Rayleigh's criterion for resolution – limit of resolution for the eye – resolving power of, (i) Prism (ii) grating (iii) telescope
UNIT-II	**INTERFERENCE:** division of wave front, Fresnel's biprism – fringes with white light – division of amplitude: interference in thin films due to, (i) reflected light, (ii) transmitted light – colours of thin films applications – air wedge – Newton's rings. *Interferometers* : Michelson's interferometer – applications, (i) determination of the wavelength of a monochromatic source of light, (ii) determination of the wavelength and separation D_1 and D_2 lines of sodium light, (iii) determination of a thickness of a mica sheet.
UNIT-III	**DIFFRACTION:** Fresnel's assumptions – zone plate – action of zone plate for an incident spherical wave front – differences between a zone plate and a convex lens –Fresnel type of diffraction – diffraction pattern due to a straight edge – positions of maximum and minimum intensities – diffraction due to a narrow slit –Fraunhofer type of diffraction – Fraunhofer diffraction at a single slit – plane diffraction grating– experiment to determine wavelengths – width of principal maxima.
UNIT-IV	**POLARISATION:** optical activity – optically active crystals – polarizer and analyser–double refraction – optic axis, principal plane

	– Huygens's explanation of double refraction in uniaxial crystals – polaroids and applications – circularlyand elliptically polarized light –quarter wave plate – half wave plate – production and detection of circularly and elliptically polarized lights – Fresnel's explanation – specific rotation – Laurent half shade polarimeter– experiment to determine specific rotatory power.
UNIT-V	**LASERS:** general principles of lasers – properties of lasers action – spontaneous and stimulated emission – population inversion – optical pumping – He-Ne laser (principle and working) – CO_2 laser (principle and working) semiconductor laser – laser applications – holography.
UNIT-VI	**PROFESSIONAL COMPONENTS:** expert lectures –seminars — webinars – industry inputs – social accountability – patriotism
TEXT BOOKS	1. Subramaniam. N andBrijlal, 2014, Optics, 25thEd,S.Chandand Co. 2. P.R.Sasikumar, 2012, Photonics, PHIPvt Ltd, New Delhi. 3. V.Rajendran, 2012, Engineering Physics, Tata McGraw Hill.
REFERENCE BOOKS	1. Sathyaprakash, 1990,Optics,VII edition, RatanPrakashanMandhir, New Delhi. 2. AjoyGhatak, 2009,Optics, 4thedition, PHIPvt Ltd, New Delhi. 3. D.Halliday,R.Resnick and J. Walker, 2001, Fundamentals of Physics,6th edition, Willey, New York. 4. 7. JenkinsA.Francis and White, 2011, Fundamentals of Optics, 4th edition, McGraw Hill Inc., NewDelhi.
WEB RESOURCES	1. https://science.nasa.gov/ems/ 2. https://www.youtube.com/watch?v=tL3rNc1G0qQandlist=RDCMUCzwo7UlGkb-8Pr6svxWo-LAandstart_radio=1andt=2472 3. https://science.nasa.gov/ems/ 4. https://imagine.gsfc.nasa.gov/educators/gammarayburststs/imagine/index.html 5. http://www.thephysicsmill.com/2014/03/23/sky-blue-lord-rayleigh-sir-raman-scattering/

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

COURSE OUTCOMES:
At the end of the course, the student will be able to:

COURSEOUTCOMES	**CO1**	Outline basic knowledge of methods of rectifying different defects in lenses, articulate technological applications of eyepieces
	CO2	Discuss the principle of superposition of wave, use these ideas to understand the wave nature of light through working of interferometer
	CO3	Extend the knowledge about nature of light through diffraction techniques; apply mathematical principles to analyse the optical instruments
	CO4	Interpret basic formulation of polarization and gain knowledge about polarimeter, appraise its usage in industries
	CO5	Relate the principles of optics to various fields of IR, Raman and UV spectroscopy and understand their instrumentation and application in industries

MAPPING WITH PROGRAM OUT COMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the 3-point scale of STRONG(**S**), MEDIUM(**M**) and LOW(**L**).

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	S	M	M	M	S	S	M	M
CO2	M	S	M	S	M	S	M	M	S	S
CO3	S	M	S	S	S	M	S	S	M	M
CO4	S	M	S	M	M	S	M	M	S	M
CO5	S	M	S	M	S	S	M	S	S	S

COURSE	FOURTH SEMESTER - CORE PRACTICAL 4
COURSETITLE	OPTICS
CREDITS	3
COURSE OBJECTIVES	Demonstrate various optical phenomena principles, working, apply with various materials and interpret the results.

Minimum of Fourteen Experiments from the list:

1. Determination of refractive index of prism using spectrometer.
2. Determination of refractive index of liquid using hollow prism and spectrometer
3. Determination of dispersive power of a prism.
4. Determination of radius of curvature of lens by forming Newton's rings.
5. Determination of thickness of a wire using air wedge.
6. Determination of Cauchy's Constants.
7. Determination of resolving power of grating
8. Determination of resolving power of telescope
9. Comparison of intensities using Lummer Brodhum Photometer.
10. Determination of range of motion using Searles goniometer.
11. Verification of Newton's formula for a lens separated by a distance.
12. Determination of refractive index of a given liquid by forming liquid lens
13. Determination of refractive index using Laser.
14. Determination of wavelengths, particle size using Laser/Monochromatic source.
15. Determination of resolving power of Diffraction grating using Laser
16. Determination of wire using Laser.
17. Focal length of convex lense
18. Focal length of concave lense
19. Diffraction grating Normal incidence.
20. Diffraction grating minimum deviation.
21. Diffraction at a wire.
22. Specific rotation of sugar solution.
23. Bi-prism – Determination of □.
24. Thickness of a thin film of Bi-prism
25. Brewster's law – polarization
26. Double refraction (□e and □o)
27. Y – by Corlus method.
28. Dispersive power of plane diffraction grating.
29. Diffraction a straight edge.
30. Kundt's tube – Velocity of sound, Adiabatic Young's modulus of the material of the rod.
31. Forbe's method – Thermal conductivity of a metal rod.
32. Spectrometer– Grating - Normal incidence - Wave length of Mercury spectral lines.
33. Spectrometer – Grating - Minimum deviation - Wave length of Mercury spectral lines.
34. Spectrometer – (i-d) curve.
35. Spectrometer – (i-i′) curve.
36. Spectrometer – Narrow angled prism.
37. Any other practicals

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

COURSE	**FIFTH SEMESTER – CORE THEORY 3**
COURSETITLE	**ELECTRICITY, MAGNETISM ANDELECTROMAGNETISM**
CREDITS	4
COURSE OBJECTIVES	To classify materials based on their electrical and magnetic properties. To analyse the working principles of electrical gadgets. To understand the behaviour of dc, ac and transient currents. To know about the communication by electromagnetic waves.

UNITS	**COURSE DETAILS**
UNIT-I	**CAPACITORS AND THERMO ELECTRICITY:** capacitor – principle – capacitance of spherical and cylindrical capacitors – capacitance of a parallel plate capacitor (with and without dielectric slab) – effect of dielectric –Carey Foster bridge – temperature coefficient of resistance – Seebeck effect – laws of thermo emf – Peltier effect – Thomson effect – thermoelectric diagrams –uses of thermoelectric diagrams – thermodynamics of thermo couple - determination of Peltier and Thomson coefficients.
UNIT-II	**MAGNETIC EFFECTS OF CURRENT:** Biot and Savart's law – magnetic induction due to circular coil – magnetic induction due to solenoid – Helmholtz tangent galvanometer –force on a current element by magnetic field – force between two infinitely long conductors – torque on a current loop in a field - moving coil galvanometer – damping correction – Ampere's circuital law – differential form – divergence of magnetic field – magnetic induction due to toroid.
UNIT-III	**MAGNETISM AND ELCTROMAGNETIC INDUCTION:** magnetic induction B – magnetization M - relation between B, H and M – magnetic susceptibility – magnetic permeability – experiment to draw B-H curve – energy loss due to hysteresis - Importance of hysteresis curves – Faraday and Lenz laws –vector form – self-induction – coefficient of self-inductance of solenoid – Anderson's method – mutual induction – coefficient of mutual inductance between two coaxial solenoids – coefficient of coupling - earth inductor- determination of angle of dip(Φ)
UNIT-IV	**TRANSIENT AND ALTERNATING CURRENTS:** growth and decay of current in a circuit containing resistance and inductance – growth and decay of charge in a circuit containing resistance and capacitor – growth and decay of charge in an LCR circuit (expressions for charge only) – peak, average and rms values of ac – LCR series and parallel circuits – resonance condition – Q factor – power factor.
UNIT-V	**MAXWELLS EQUATIONS AND ELECTROMAGNETIC WAVES:** Maxwell's equations in vacuum, material media– physical significance of Maxwell's equations –displacement current – plane electromagnetic waves in free space – velocity of light – Poynting vector–electromagnetic waves in a linear homogenous media – refractive index.
UNIT-VI	**PROFESSIONAL COMPONENTS:**expert lectures –seminars — webinars – industry inputs – social accountability – patriotism

TEXT BOOKS	1. Murugeshan. R., - Electricity and Magnetism, 8thEdn, 2006, S.Chandand Co, New Delhi.\ 2. Sehgal D.L., Chopra K.L, Sehgal N.K., - Electricity and Magnetism, 3. Sultan Chand and Sons, New Delhi. 4. M. Narayanamurthy and N. Nagarathnam, Electricity and Magnetism, 4th Edition. 5. National Publishing Co., Meerut.
REFERENCE BOOKS	1. 1. Brijlal and Subramanian, Electricity and Magnetism, 6th Edn.,Ratanand Prakash, Agra. 2. Brijlal, N.Subramanyan and JivanSeshan, Mechanics and Electrodynamics (2005), 3. Eurasia Publishing House (Pvt.) Ltd., New Delhi. 4. David J. Griffiths, Introduction to Electrodynamics, 2ndEdn. 1997, Prentice Hall of 5. India Pvt. Ltd., New Delhi 6. D. Halliday, R. Resnik and J. Walker - Fundamentals of Physics, 6thEdn., Wiley, NY, 2001.
WEB RESOURCES	8. https://www.edx.org/course/electricity 9. https://www.udemy.com/courses/ electricity 10. https://www.edx.org/course/magnetism 11. http://www.hajim.rochester.edu/optics/undergraduate/courses.html

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

COURSE OUTCOMES:

At the end of the course, the student will be able to:

COURSEOUTCOMES	**CO1**	Describe various thermo-electric effects and their properties.
	CO2	Apply Biot and Savart law to study the magnetic effect of electric current.
	CO3	Use Faraday and Lenz laws in explaining self and mutual inductance.
	CO4	Analyze the time variation of current and potential difference in AC circuits.
	CO5	Relate different physical quantities used to explain magnetic properties of materials.

MAPPING WITH PROGRAM OUT COMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the 3-point scale of STRONG(**S**), MEDIUM(**M**) and LOW(**L**).

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	S	S	M	S	M
CO2	M	S	S	S	M	S	S	M	M	M
CO3	S	S	S	M	S	S	S	M	S	M
CO4	S	S	S	S	S	S	S	M	M	M
CO5	S	S	M	S	S	S	M	M	S	M

COURSE	**FIFTH SEMESTER - CORE**
COURSE TITLE	**ATOMIC and NUCLEAR PHYSICS**
CREDITS	4
COURSE OBJECTIVES	To make students understand the development of atom models, quantum numbers, coupling schemes and analysis of magnetic moments of an electrons; To gain knowledge on excitation and ionization potentials, splitting of spectral lines in magnetic and electric fields; To get knowledge on radioactive decay; To know the concepts used in nuclear reaction; to understand the quark model of classification of elementary particles.

UNITS	COURSE DETAILS
UNIT-I	**VECTOR ATOM MODEL:** introduction to atom model – vector atom model – electron spin –spatial quantisation– quantum numbers associated with vector atom model – L-S and J-J coupling – Pauli's exclusion principle – magnetic dipole moment due to orbital motion and spin motion of the electron – Bohr magnetron – Stern-Gerlach experiment – selection rules – intensity rule.
UNIT-II	**ATOMIC SPECTRA:** origin of atomic spectra – excitation and ionization potentials – Davis and Goucher's method – spectral terms and notations – fine structure of sodium D-lines – Zeeman effect –Larmor's theorem – quantum mechanical explanation of normal Zeeman effect – anomalous Zeeman effect (qualitative explanation) –Paschen-Back effect – Stark effect.
UNIT-III	**RADIOACTIVITY:** discovery of radioactivity – natural radio activity – properties of alpha rays, beta rays and gamma rays – Geiger-Nuttal law – alpha particle spectra –Gammow's theory of alpha decay (qualitative study) – beta ray spectra – neutrino theory of beta decay – nuclear isomerism – internal conversion – non-conservation of parity in weak interactions.
UNIT-IV	**NUCLEAR REACTIONS:** conservation laws of nuclear reaction – Q-value equation for a nuclear reaction – threshold energy – scattering cross section – artificial radio activity – application of radio isotopes – classification of neutrons – models of nuclear structure – liquid drop model – shell model.
UNIT-V	**ELEMENTARY PARTICLES:** classification of elementary particles – fundamental interactions – elementary particle quantum numbers –iIsospin and strangness quantum number – Conservation laws and symmetry – quarks – quark model (elementary ideas only) – discovery of cosmic rays – primary and secondary cosmic rays – latitude effect– altitude effect.
UNIT-VI	**PROFESSIONAL COMPONENTS:** expert lectures –seminars – – webinars – industry inputs – social accountability – patriotism
TEXT BOOKS	1. R. Murugesan, Modern Physics, S. Chand and Co**. (**All units**)** (Units I and II-Problems) 2. Brijlaland N. Subrahmanyam, Atomic and Nuclear Physics, S.

	Chand and Co. (All units) 3. J. B. Rajam, Modern Physics, S. Chand and Co. 4. Sehgal and Chopra, Modern Physics, Sultan Chand, New Delhi 5. Arthur Beiser – Concept of Modern Physics, McGraw Hill Publication, 6th Edition.
REFERENCE BOOKS	1. Perspective of Modern Physics, Arthur Beiser, McGraw Hill. 2. Modern Physics, S. Ramamoorthy, National Publishing and Co. 3. Laser and Non-Linear Optics by B.B.Laud, Wiley Easter Ltd.,New York,1985. 4. Tayal, D.C.2000 – Nuclear Physics, Edition, Himalaya Publishing House, Mumbai. 5. Irving Kaplan (1962) Nuclear Physics, Second Edition, Oxford and IBH Publish and Co, New Delhi. 6. J.B. Rajam– Atomic Physics, S. Chand Publication, 7th Edition. 7. Roy and Nigam, – Nuclear Physics (1967) First edition, Wiley Eastern Limited, New Delhi.
WEB RESOURCES	1. http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html 2. https://makingphysicsfun.files.wordpress.com/2015/01/photoelectric-effect.pptx 3. https://www.khanacademy.org/science/physics/quantum-physics/in-in-nuclei/v/types-of-decay 4. https://www.khanacademy.org/science/in-in-class-12th-physics-india/nuclei

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

COURSE OUTCOMES:
At the end of the course, the student will be able to:

COURSEOUTCOMES	**CO1**	List the properties of electrons and positive rays, define specific charge of positive rays and know about different mass spectrographs.
	CO2	Outline photoelectric effect and the terms related to it, State laws of photoelectric emission, Explain experiments and applications of photo electric effect, Solve problems based on photoelectric equation.
	CO3	Explain different atom models, Describe different quantum numbers and different coupling schemes.
	CO4	Differentiate between excitation and ionization potentials, Explain Davis and Goucher's experiment, Apply selection rule, Analyse Paschen-Back effect, Compare Zeeman and Stark effect.
	CO5	Understand the condition for production of laser, Appreciate various properties and applications of lasers.

MAPPING WITH PROGRAM OUT COMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the 3-point scale of STRONG(**S**), MEDIUM(**M**) and LOW(**L**).

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	S	S	M	S	M
CO2	S	S	M	S	M	S	S	M	M	M
CO3	S	S	S	M	S	S	M	S	S	S
CO4	M	S	S	S	S	M	S	M	M	M
CO5	S	M	S	S	M	S	S	M	M	S

COURSE	**FIFTH SEMESTER – CORE**
COURSETITLE	**ANALOG AND COMMUNICATION ELECTRONICS**
CREDITS	4
COURSE OBJECTIVES	To study the design, working and applications of semiconducting devices. To construct various electronic circuits. To study them in details. To study the basis of audio and video communication systems and the aspects of satellite and Fibre Optic Communications.

UNITS	**COURSE DETAILS**
UNIT-I	**DIODES:** diode characteristics – rectifiers - clipper circuits, clamping circuits. half wave rectifier, center tapped and bridge full wave rectifiers, calculation of efficiency and ripple factor. DC power supply: Block diagram of a power supply, qualitative description of shunt capacitor filter, Zener diode as voltage regulator, temperature coefficient of Zener diode.
UNIT-II	**TRANSISTOR AMPLIFIERS:** transistor configurations: CB, CE CC modes – I-V characteristics and hybrid parameters – DC load line – Q point self-bias – RC coupled CE amplifier –power amplifiers – classification of power amplifiers: A, B, C – push pull amplifiers – tuned amplifiers.
UNIT-III	**TRANSISTOR OSCILLATORS:** feedback amplifier - principle of feedback, positive and negative feedback of voltage and current gain, advantages of negative feedback - Barkhausen's criterion. Transistor oscillators: Hartely, Colpitt, Phase shift oscillators with mathematical analysis.
UNIT-IV	**OPERATIONAL AMPLIFIERS:** differential amplifiers – OPAMP characteristics –IC 741 pin configuration – inverting and non-inverting amplifiers – unity follower –summing and difference amplifiers – differentiator and integrator – astable multivibrator (square wave generator) – monostable vibrator
UNIT-V	**MODULATION AND DEMODULATION t**heory of amplitude modulation - frequency modulation – comparison of AM and FM – phase modulation – sampling theorem – pulse width modulation – pulse modulation systems: PAM, PPM, and PCM – demodulation: AM and FM detection - duper heterodyne receiver (block diagram)
UNIT-VI	**PROFESSIONAL COMPONENTS:** expert lectures –seminars – – webinars – industry inputs – social accountability – patriotism
TEXT BOOKS	1. V.K.Mehta - Principles of Electronics, S.Chand and Co. Ltd., 2004. 2. V.Vijayendran - Integrated Electronics, S.Vishwanathan Publishers, Chennai. 3. B.L. Theraja - A Text Book of Electrical Technology. 4. John D. Ryder - Electronic fundamentals and Applications. 5. Malvino - Electronic Principles, Tata McGraw Hill.

REFERENCE BOOKS	1. B. Grob - Basic Electronics, 6th edition, McGraw Hill, NY, 1989. 2. Herbert Taub and Donald schilling - Digital Integrated Electronics, McGraw Hill, NY. 3. Ramakant A. – Op amp principles and linear integrated circuits, Gaykward 4. Bagde and S. P. Singh - Elements of Electronics. 5. Millman and Halkias- Integrated Electronics, Tata McGraw Hill.
WEB RESOURCES	1. https://www.queenmaryscollege.edu.in/eresources/undergraduateprogram/py157 2. www.ocw.mit.edu>...> Circuits and Electronics 3. www.ocw.mit.edu>...> Introductory Analog Electronics Laboratory 4. https:// www.elprocus.com> semiconductor devices 5. https:// www.britannica.com>technology

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

COURSE OUTCOMES:

At the end of the course, the student will be able to:

COURSEOUTCOMES	**CO1**	Explain the basic concepts of semiconductors devices.
	CO2	know and classify the basic principles of biasing and transistor amplifiers
	CO3	Acquire the fundamental concepts of oscillators.
	CO4	Understand the working of operational amplifiers
	CO5	Learn and analyze the operations of sequential and combinational digital circuits

MAPPING WITH PROGRAM OUT COMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the 3-point scale of STRONG(**S**), MEDIUM(**M**) and LOW(**L**).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	M	S	M
CO2	S	S	M	S	M	M	S	M	M	M
CO3	M	M	S	L	S	S	L	S	S	S
CO4	M	S	S	S	S	S	S	M	L	M
CO5	S	M	S	S	M	M	S	M	M	S

COURSE	**FIFTH SEMESTER – CORE PRACTICAL 5**
COURSETITLE	**ELECTRICITY AND MODERN PHYSICS**
CREDITS	3
COURSE OBJECTIVES	Demonstrate various electrical circuits, bridges circuits and measurement of physical constants of modern physics.

Minimum of Fourteen Experiments from the list:

1. Calibration of low range and high range voltmeter using potentiometer
2. Calibration of ammeter using potentiometer.
3. Measurement of low resistances using potentiometer.
4. Determination of field along the axis of a current carrying circular coil.
5. Determination of earth's magnetic field using field along axis of current carrying coil.
6. Determination of specific resistance of the material of the wire using PO box.
7. Determination of resistance and specific resistance using Carey Foster's bridge.
8. Determination of internal resistance of a cell using potentiometer.
9. Determination of specific conductance of an electrolyte.
10. Determination of e.m.f of thermo couple using potentiometer
11. Determination of capacitance using Desauty's bridge and B.G./Spot galvanometer/head phone.
12. Determination of figure of merit of BG or spot galvanometer.
13. Comparison of EMF of two cells using BG.
14. Comparison of capacitance using BG.
15. Owen's Bridge
16. De Sauty's bridge
17. LCR series resonant circuit
18. Rydberg's constant
19. e/m Thomson method
20. h by photocell
21. Spectral response of photo conductor (LDR).
22. Potentiometer –Resistance and Specific resistance of the coil.
23. Potentiometer – E.M.F of a thermocouple.
24. Carey Foster's bridge - Temperature coefficient of resistance of the coil.
25. Deflection Magnetometer – Determination of Magnetic moment of a bar magnet and $B_H$using circular coil carrying current.
26. Vibration magnetometer - Determination of B_H using circular coil carrying current– Tan B position.
27. B.G – Figure of Merit – Charge Sensitivity
28. Any other practicals

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

COURSE	**SIXTHSEMESTER – CORE**
COURSETITLE	**QUANTUM MECHANICS AND RELATIVITY**
CREDITS	4
COURSE OBJECTIVES	To understand the theory of relativity, its postulates and the consequences. To learn the importance of transformation equations and also to differentiate between special and general theory of relativity. To interpret the wave theory of matter with various theoretical and experimental evidences. To derive and use Schrodinger's wave equation and also learn about various operators. To solve Schrodinger's wave equation for simple problems and analyse to understand the solutions.

UNITS	COURSE DETAILS
UNIT-I	**SPECIAL THEORY OF RELATIVITY:** Michelson-Morley experiment–frames of reference – Galilean Relativity – postulates of special theory of relativity – Lorentz transformation – consequences – time dilation–concept of simultaneity – Doppler effect – length contraction–variation of mass with velocity – Einstein's mass-energy relation– relativistic momentum – energy relation
UNIT-II	**TRANSFORMATION RELATIONS:** transformation of velocity, mass, energy and momentum – four vector – invariance under transformation – Lorentz transformation and velocity addition equations in terms of hyperbolic functions. **GENERAL THEORY OF RELATIVITY:** Inertial and Gravitational mass – Principle of equivalence – Experimental evidences for General theory of Relativity
UNIT-III	**PHOTONS AND MATTER WAVES:** difficulties of classical physics and origin of quantum theory – black body radiation – Planck's law – Einstein's photoelectric equation – Compton effect – pair production – De Broglie waves – phase velocity and group velocity – Davisson and Germer's experiment – uncertainty principle – consequences – illustration of Gamma ray microscope.
UNIT-IV	**OPERATORS AND SCHRÖDINGER EQUATION:** postulates of quantum mechanics – Wave function and its interpretation – Schrödinger's equation – linear operators – Eigenvalue – Hermitian operator – properties of Hermitian operator– observable – operators for position, linear Momentum, angular momentum components –commutator algebra –commutator between these operators –expectation values of position and momentum – Ehrenfest theorem.
UNIT-V	**SOLVING SCHRÖDINGER EQUATION FOR SIMPLE PROBLEMS:** *one-dimensional problems*: (i) particle in a box, (ii) barrier penetration problem – quantum mechanical tunneling, (iii) linear harmonic oscillator. *higher dimensional problems*: (i) Rigid rotator (qualitative), (ii) Hydrogen atom (qualitative).

UNIT-VI	**PROFESSIONAL COMPONENTS:** expert lectures –seminars – – webinars – industry inputs – social accountability – patriotism
TEXT BOOKS	1. Modern Physics, R. Murugeshan, KiruthigaSivaprasath,S. Chand and Co.,17th Revised Edition, 2014. 2. Concepts of Modern Physics, A.Beiser, 6th Ed., McGraw-Hill, 2003. 3. Special Theory of Relativity,S. P.Puri, Pearson Education, India, 2013. 4. Quantum Mechanics, Ghatak and Loganathan, Macmillan Publications. 5. Quantum mechanics – Satyaprakash and Swati Saluja. KedarNath Ram Nathand Co.
REFERENCE BOOKS	1. Fundamentals of Modern Physics, Peter J. Nolan, 1stEdition, 2014, by Physics 2. Quantum Mechanics, V. Devanathan, Narosa Pub. House, Chennai, 2005. 3. Quantum Mechanics, V.K. Thangappan, New Age International, New Delhi. 4. A Text Book of Quantum Mechanics, Mathews and Venkatesan, Tata McGraw Hill, New Delhi. 5. Introduction to Quantum Mechanics, Pauling and Wilson, McGraw Hill Co., NewYork.
WEB RESOURCES	1. http://hyperphysics.phy-astr.gsu.edu/hbase/qapp.html 2. https://swayam.gov.in/nd2_arp19_ap83/preview 3. https://swayam.gov.in/nd1_noc20_ph05/preview 4. https://www.khanacademy.org/science/physics/special-relativity/minkowski-spacetime/v/introduction-to-special-relativity-and-minkowski-spacetime-diagrams

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

COURSE OUTCOMES:
At the end of the course, the student will be able to:

COURSEOUTCOMES	**CO1**	Understand various postulates of special theory of relativity.
	CO2	Appreciate the importance of transformation equations and also the general theory of relativity.**.**
	CO3	Realise the wave nature of matter and understand its importance
	CO4	Derive Schrodinger equation and also realize the use of operators.
	CO5	Apply Schrödinger equation to simple problems.

MAPPING WITH PROGRAM OUT COMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the 3-point scale of STRONG(**S**), MEDIUM(**M**) and LOW(**L**).

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	S	S	M	S	M
CO2	S	S	M	S	M	M	S	M	M	M
CO3	M	M	S	M	S	S	M	S	S	S
CO4	M	S	S	S	S	S	S	M	M	M
CO5	S	M	S	S	M	M	S	M	M	S

COURSE	**SIXTH SEMESTER – CORE**
COURSETITLE	**SOLID STATE PHYSICS**
CREDITS	4
COURSE OBJECTIVES	To understand constituents, properties and models of nucleus. To give reason for radioactivity and study their properties. To learn about the principles of various particle detectors and accelerators. To acquire knowledge on different types of nuclear reactions and their applications. To know the reason for cosmic rays and their effect on the surface of earth and also understand the classification of elementary particles.

UNITS	COURSE DETAILS
UNIT-I	**BONDING IN SOLIDS, CRYSTAL STRUCTURE:** types of bonding –ionic bonding – bond energy of NaCl molecule –covalent bonding – metallic bonding – hydrogen bonding – Van-der-Waals bonding – crystal lattice – lattice translational vectors – lattice with basis – unit cell – Bravais' lattices – Miller indices – procedure for finding them –packing of BCC and FCC structures – structures of NaCl and diamond crystals –reciprocal lattice – reciprocal lattice vectors – properties – reciprocal lattices to SC, BCC and FCC structures – Brillouin zones – X-rays – Bragg's law(simple problems) – experimental methods: Laue method, powder method and rotating crystal method
UNIT-II	**ELEMENTARY LATTICE DYNAMICS:** lattice vibrations and phonons: linear monoatomicand diatomic chains. acoustical and optical phonons –qualitativedescription of the phonon spectrum in solids –Dulong and Petit's Law – Einstein and Debye theories ofspecific heat of solids – T^3 law (qualitative only)–properties of metals – classical free electron theory of metals(Drude-Lorentz) – Ohm's law – electrical and thermal conductivities – Weidemann-Franz' law –Sommerfeld's quantum free electron theory (qualitative only) – Einstein's theory of specific heat capacity.
UNIT-III	**MAGNETIC PROPERTIES OF SOLIDS:** permeability, susceptibility, relation between them – classification of magnetic materials – properties ofdia, para, ferro, ferri and antiferromagnetism –Langevin's theory of diamagnetism – Langevin's theory of paramagnetism – Curie-Weiss law – Weiss theory of ferromagnetism(qualitative only) – Heisenberg's quantum theory of ferromagnetism – domains – discussion of B-H curve –hysteresis and energy loss – soft and hard magnets – magnetic alloys.
UNIT-IV	**DIELECTRIC PROPERTIES OF MATERIALS:** polarization and electric susceptibility –local electric field of an atom – dielectric constant and polarisability – polarization processes: electronic polarization– calculation of polarisability – ionic, orientational and space charge polarization –internal field –Clausius-Mosotti relation – frequency dependence of dielectric constant –dielectric loss – effect of temperature on dielectric constant – dielectric breakdown and its types – classical theory of electric polarisability –normal and

	anomalous dispersion – Cauchy and Sellmeir relations –Langevin-Debye equation – complex dielectric constant -optical phenomena. Application – plasma oscillations – plasma frequency –plasmons,
UNIT-V	**FERROELECTRIC and SUPERCONDUCTING PROPERTIES OF MATERIALS:** *ferroelectric effect*: Curie-Weiss Law – ferroelectric domains, P-E hysteresis loop – *elementary band theory:* Kronig-Penny model – band gap(no derivation) – conductor, semiconductor (P and N type) and insulator –conductivity of semiconductor – mobility – Hall effect – measurement of conductivity (four probe method) - Hall coefficient. *Superconductivity:* experimental results –critical temperature – critical magnetic field – Meissner effect –type-I and type-II superconductors – London's equation and penetration depth – isotope effect – idea of BCS theory (no derivation)
UNIT-VI	**PROFESSIONAL COMPONENTS:** expert lectures –seminars — webinars – industry inputs – social accountability – patriotism
TEXT BOOKS	1. Introduction to Solid State Physics, Kittel, Willey Eastern Ltd (2003). 2. Solid state Physics, Rita John,1st edition, Tata McGraw Hill publishers (2014). 3. Solid State Physics , R L Singhal, Kedarnath Ram Nath and Co., Meerut (2003) 4. Elements of Solid State Physics, J.P. Srivastava, 2nd Edition, 2006, Prentice-Hall of India 5. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill 6. Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning 7. Solid-state Physics, H. Ibach and H. Luth, 2009, Springer 8. Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India 9. Solid State Physics, M.A. Wahab, 2011, Narosa Publishing House, ND
REFERENCE BOOKS	1. Puri and Babber – Solid State Physics – S.Chand and Co. New Delhi. 2. Kittel - Introduction to solid state physics, Wiley and Sons, 7th edition. 3. Raghavan - Materials science and Engineering, PHI 4. Azaroff - Introduction to solids, TMH 5. S. O. Pillai - Solid State Physics, Narosa publication 6. A.J. Dekker - Solid State Physics, McMillan India Ltd. 7. Elements of Solid State Physics, J.P. Srivastava, 2nd Edition, 2006, Prentice-Hall of India
WEB RESOURCES	1. https://nptel.ac.in/courses/115105099/ 2. https://nptel.ac.in/courses/115106061/

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

COURSE OUTCOMES:
At the end of the course, the student will be able to:

COURSEOUTCOMES	**CO1**	Classify the bonding and crystal structure also learn about the crystal structure analysis using X ray diffraction.
	CO2	Understand the lattice dynamics and thus learn the electrical and thermal properties of materials.
	CO3	Give reason for classifying magnetic material on the basis of their behaviour.
	CO4	Comprehend the dielectric behavior of materials.
	CO5	Appreciate the ferroelectric and super conducting properties of materials.

MAPPING WITH PROGRAM OUT COMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the 3-point scale of STRONG(**S**), MEDIUM(**M**) and LOW(**L**).

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	S	S	S	S	S	M	S	S
CO2	M	S	M	S	M	M	S	M	M	M
CO3	S	M	S	M	S	M	M	S	S	S
CO4	S	S	S	S	M	S	S	M	M	M
CO5	S	M	M	S	S	M	S	M	M	S

COURSE	**SIXTH SEMESTER – CORE**
COURSETITLE	**DIGITAL ELECTRONICS AND MICROPROCESSOR 8085**
CREDITS	4
COURSE OBJECTIVES	To learn all types of number systems, Boolean algebra and identities, digital circuits for addition and subtraction, flip-flops, registers, counters. To get the knowledge on fundamentals of 8085 architecture, instruction sets and simple programs.

UNITS	**COURSE DETAILS**
UNIT-I	decimal, binary, octal, hexadecimal numbers systems and their conversions – codes: BCD, gray and excess-3 codes –code conversions –complements (1's, 2's, 9's and 10's) –binary addition, binary subtraction using 1's and 2's complement methods – Boolean laws – De-Morgan's theorem –basic logic gates -universal logic gates (NAND and NOR) –standard representation of logic functions (SOP and POS) – minimization techniques (Karnaughmap: 2, 3, 4 variables).
UNIT-II	adders, half and full adder –subtractors, half and full subtractor – parallel binary adder – magnitude comparator – multiplexers (4:1) and demultiplexers (1:4), encoder (8-line-to-3- line) and decoder (3-line-to-8-line), BCD to seven segment decoder.
UNIT-III	flip-flops: S-R Flip-flop , J-K Flip-flop, T and D type flip-flops, master-slave flip-flop, truth tables, registers:- serial in serial out and parallel in and parallel out – counters asynchronous:-mod-8, mod-10, synchronous - 4-bit andring counter – general memory operations, ROM, RAM (static and dynamic), PROM, EPROM, EEPROM, EAROM. IC – logic families: RTL, DTL, TTL logic, CMOS NAND and NOR Gates, CMOS Inverter, Programmable Logic Devices – Programmable Logic Array (PLA), Programmable Array Logic (PAL).
UNIT-IV	8085 Microprocessor: introduction to microprocessor – INTEL 8085 architecture – register organization –pin configuration of 8085, interrupts and its priority – Program Status Word (PSW) –instruction set of 8085 –addressing modes of 8085 –assembly language programming using 8085 –programmes for addition (8-Bit and 16-Bit), subtraction (8-Bit and 16-Bit), multiplication (8- Bit), division (8- Bit) – largest and smallest number in an array – BCD to ASCII and ASCII to BCD.
UNIT-V	I/O Interfaces: serial communication interface (8251-USART) – programmable peripheral interface (8255-PPI) –programmable interval timers (8253) – keyboard and display (8279), DMA controller (8237).
UNIT-VI	**PROFESSIONAL COMPONENTS:** expert lectures –seminars — webinars – industry inputs – social accountability – patriotism

TEXT BOOKS	1. M.Morris Mano, "Digital Design "3rd Edition, PHI, New Delhi. 2. Ronald J. Tocci. "Digital Systems-Principles and Applications" 6/e. PHI. New Delhi. 1999.(UNITS I to IV) 3. S.Salivahana and S. Arivazhagan-Digital circuits and design 4. Microprocessor Architecture, Programming and Applications with the 8085 – Penram International Publishing, Mumbai.- Ramesh S.Gaonakar 5. Microcomputer Systems the 8086/8088 family – YU-Cheng Liu and GlenSA
REFERENCE BOOKS	1. Herbert Taub and Donald Schilling. "Digital Integrated Electronics" . McGraw Hill. 1985. 2. S.K. Bose. "Digital Systems". 2/e. New Age International.1992. 3. D.K. Anvekar and B.S. Sonade. "Electronic Data Converters: Fundamentals and Applications". TMH.1994. 4. Malvino and Leach. "Digital Principles and Applications". TMG Hill Edition 5. Microprocessors and Interfacing – Douglas V.Hall 6. Microprocessor and Digital Systems – Douglas V.Hall
WEB RESOURCES	1. https://youtu.be/-paFaxtTCkI 2. https://youtu.be/s1DSZEaCX_g

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

COURSE OUTCOMES:
At the end of the course, the student will be able to:

COURSEOUTCOMES	**CO1**	Learn about number systems, Boolean algebra, logical operation and logic gates
	CO2	Understand the working of adder, subractors, multiplexers and demultiplexers.
	CO3	Get knowledge on flip-flops and storage devices.
	CO4	Gain inputs on architecture of microprocessor 8085.
	CO5	Develop program writing skills .on microprocessor 8085.

MAPPING WITH PROGRAM OUT COMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the 3-point scale of STRONG(**S**), MEDIUM(**M**) and LOW(**L**).

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	S	S	S	S	S	M	S	S
CO2	M	S	M	S	M	M	S	M	M	M
CO3	S	M	S	M	S	M	M	S	S	S
CO4	S	S	S	S	M	S	S	M	M	M
CO5	S	M	M	S	S	M	S	M	M	S

COURSE	**SIXTH SEMESTER – CORE PRACTICAL 6**
COURSETITLE	**DIGITAL ELECTRONICS AND MICROPROCESSOR**
CREDITS	3
COURSE OBJECTIVES	To perform basic experiments on characteristics of electronic devices and then get into the applications such as amplifiers, oscillators, counters, multivibrators. Perform fundamental experiments on microprocessor 8085 and learn to write programs by themselves.

Minimum of Fourteen Experiments from the list:

1. Transistor Emitter follower.
2. Colpitt's oscillator -transistor.
3. Hartley oscillator - transistor.
4. Astable multivibrator - transistor.
5. Bistable multivibrator - transistor.
6. FET - characteristics.
7. FET - amplifier (common drain)
8. UJT -characteristics
9. AC circuits with L,C,R -Series resonance.
10. AC circuits with L,C,R - Parallel resonance.
11. Operational amplifier - inverting amplifier and summing.
12. Operational amplifier - non-inverting amplifier and summing.
13. Operational amplifier – differential amplifier
14. Operational amplifier - differentiator and integrator.
15. Operational amplifier - D/A converter by binary resistor method.
16. 5V, IC Regulated power supply.
17. Construction of seven segment display.
18. Study of gate ICs – NOT, OR, AND, NOR, NAND, XOR, XNOR
19. Verification of De Morgan's theorem using ICs –NOT, OR, AND
20. NAND as universal building block.
21. NOR as universal building block.
22. Half adder / Half subtractor using basic logic gate ICs
23. Microprocessor 8085 – addition (8 bit only)
24. Microprocessor 8085 – subtraction (8 bit only)
25. Microprocessor 8085 – multiplication (8 bit only)
26. Microprocessor 8085 – division (8 bit only)
27. Microprocessor 8085 – square (8 bit only)
28. Microprocessor 8085 – square root (8 bit only)
29. Microprocessor 8085 – largest/smallest of numbers (8 bit only)
30. Microprocessor 8085 –ascending/descending order
31. Microprocessor 8085 – Fibonacci series
32. Any other practicals

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

LIST OF ELECTIVE COURSES (EC)

STUDENTS CAN CHOOSE ANY OF THESES COURSES IN SEM V AND VI

COMMUNICATION PHYSICS	
Learning Objective: To get a thorough knowledge on transmission and reception of radio waves, the different types of communication like fibre optic, radar, satellite, cellular	
UNITS	**COURSE DETAILS**
UNIT-I	**RADIO TRANSMISSION AND RECEPTION:** transmitter – modulation types of modulation – amplitude modulation – limitations of amplitude modulation – frequency modulation – comparison of FM and AM – demodulation- essentials in demodulation – receivers: AM radio receivers – types of AM radio receivers – stages of superheterodyne radio receiver, advantages – FM receiver – difference between FM and AM receivers.
UNIT-II	**FIBER OPTIC COMMUNICATION:** introduction – basic principle of fiber optics – advantages – construction of optical fiber – classification based on the refractive index profile – classification based on the number of modes of propagation – losses in optical fibers – attenuation–advantages of fiber optic communication
UNIT-III	**RADAR COMMUNICATION: i**ntroduction - basic radar system –radar range – antenna scanning –pulsed radar system – search radar –tracking radar – moving target indicator Doppler effect-MTI principle – CW Doppler radar
UNIT-IV	**SATELLITE COMMUNICATION:** introduction history of satellites – satellite communication system – satellite orbits – basic components of satellite communication system – commonly used frequency in satellite – communication –multiple access communication – satellite communication in India
UNIT-V	**MOBILE COMMUNICATION:** introduction – concept of cell – basic cellular mobile radio system – cell phone – facsimile – important features of fax machine – application of facsimile – VSAT (very small aperture terminals) modem IPTV (internet protocol television) -Wi-Fi-4G (basic ideas)
TEXT BOOKS	1. V.K. Metha, Principles of Electronics, S. Chand and CoLtd., 2013 2. Anokh Singh and Chopra A.K., Principles of communication Engineering, S.Chand and Co, 2013
REFERENCE BOOKS	1. J.S. Chitode, Digital Communications, 2020, Unicorn publications 2. Senior John. M, Optical Fiber Communications: Principles and Practice, 2009, Pearson Education.

METHOD OF EVALUATION:

Continuous InternalAssessment	End Semester Examination	Total	Grade
25	**75**	**100**	

ENERGY PHYSICS	
Learning Objective: To get the understanding of the conventional and non-conventional energy sources, their conservation and storage systems.	
UNITS	**COURSE DETAILS**
UNIT-I	**INTRODUCTION TO ENERGY SOURCES:** energy consumption as a measure of prosperity – world energy future – energy sources and their availability – conventional energy sources – non-conventional and renewable energy sources – comparison – merits and demerits.
UNIT-II	**SOLAR ENERGY:** solar energy Introduction – solar constant – solar radiation at the Earth's surface – solar radiation geometry – Solar radiation measurements – solar radiation data –solar energy storage and storage systems – solar pond – solar cooker – solar water heater – solar greenhouse – types of greenhouses – solar cells.
UNIT-III	**WIND ENERGY:** introduction –nature of the wind – basic principle of wind energy conversion – wind energy data and energy estimation – basic components of Wind Energy Conversion Systems (WECS) – advantages and disadvantages of WECS – applications – tidal energy
UNIT-IV	**BIOMASS ENERGY:** introduction – classification – biomass conversion technologies –photosynthesis – fermentation - biogas generation –classification of biogas plants – anaerobic digestion for biogas – wood gasification – advantages and disadvantages.
UNIT-V	**ENERGY STORAGE:** importance of energy storage- batteries - lead acid battery -nickel-cadmium battery – fuel cells – types of fuel cells – advantages and disadvantages of fuel cells – applications of fuel cells - hydrogen storage.
TEXT BOOKS	1. G.D.Rai, Non-Conventional Sources of Energy, Khanna Publishers, 2009, 4th Edn. 2. S P Sukhstme, J K Nayak, Solar Energy, Principles of Thermal Collection and Storage, McGraw Hill, 2008, 3rd Edn. 3. D P Kothari, K P Singal, RakeshRajan, PHI Learning Pvt Ltd, 2011, 2nd Edn.
REFERENCE BOOKS	1. John Twidelland Tony Weir, Renewable Energy Resources, Taylor and Francis, 2005, 2nd Edn. 2. S.A. Abbasi and Nasema Abbasi, Renewable Energy sources and their environmental impact, PHI Learning Pvt. Ltd, 2008. 3. M. P. Agarwal, Solar Energy, S. Chand and Co. Ltd., New Delhi,1982 4. H. C. Jain, Non-Conventional Sources of Energy, Sterling Publishers,1986.

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

MATHEMATICAL PHYSICS	
Learning Objective: To understand higher mathematical concepts which are applied to solve problems in Physics and similar situations	
UNITS	**COURSE DETAILS**
UNIT-I	**MATRICES:** types of matrices – symmetric, Hermitian, unitary and orthogonal matrices– characteristic equation of a matrix – Eigen values and Eigen vectors of a matrix – Cayley-Hamilton theorem – inverse of matrix by Cayley-Hamilton theorem – similarity transformations – diagonalization of 2x2 real symmetric matrices.
UNIT-II	**VECTOR CALCULUS:** vector differentiation – directional derivatives –definitions and Physical significance of gradient, divergence, curl – Laplace operators– vector identities – line, surface and volume integrals – statement, proof and simple problems for Gauss's divergence theorem, Stoke's theorem, Green's theorem.
UNIT-III	**ORTHOGONAL CURVILINEAR COORDINATES:** tangent basis vectors – scale factors – unit vectors in cylindrical and spherical coordinate systems –gradient of a scalar –divergence and curl of a vector – Laplacian in these coordinate systems.
UNIT-IV	**FOURIER SERIES:** periodic functions –Dirichlet's conditions – general Fourier series – even and odd functions and their Fourier expansions – Fourier cosine and sine – half range series – change of length of interval. Fourier analysis of square wave, saw-tooth wave, half wave/full wave rectifier wave forms. **FOURIER TRANSFORMS**: Fourier Integral theorem(Statement only)–Fourier, Fourier sine and Fourier cosine transforms,– Fourier transform ofsingle pulse – trigonometric,exponential and Gaussianfunctions – inverse Fourier transform – convolution theorem.
UNIT-V	**APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS (PDE):** PDE for transverse vibrations in elastic strings (one dimensional wave equation) –one dimensional heat flow equation – solutions to these PDE's by method of separation of variables – problems based on boundary conditions and initial conditions.
TEXT BOOKS	1. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India. 2. Mathematical Physics – P. K. Chattopadhyay, New Age International Publishers. 3. Mathematical Physics – B. D. Gupta. 4. Mathematical Physics – H. K. Das, S. Chand and Co, New Delhi.
REFERENCE BOOKS	1. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill. 2. Engineering Mathematics III- B, M. K. Venkataraman, 3. Applied Mathematics for Scientists and Engineers, Bruce R. Kusseand Erik A. Westwig, 2nd Ed, WILEY-VCH Verlag, 2006. 4. Vector space and Matrices – J. C. Jain, Narosa Publishing House Pvt. Ltd.

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
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ADVANCED MATHEMATICAL PHYSICS	
Learning Objective: The fundamentals of matrices and vector calculus learnt in earlier course will enable students to learn advanced topics and theorems. The special functions and applications of partial differential equations will be of use in research at a later stage.	
UNITS	**COURSE DETAILS**
UNIT-I	**MATRICES: i**ntroduction – special types of matrices – transpose – conjugate– conjugate transpose– symmetric and anti symmetric – Hermitian and skew Hermitian – orthogonal and unitary – properties – characteristic equation – roots and characteristic vectors – diagonalization– Cayley–Hamilton theorem –simple problems
UNIT-II	**VECTOR CALCULUS:**∇operator – divergence – second derivative of vector functions or fields –Laplacian operator – curl of a vector – line integral – line Integral of a vector field around an infinitesimal rectangle – curl of conservative field – surface integral – volume integral (without problem) – Gauss's divergence theorem and proof – Stroke's theorem and proof –simple problems.
UNIT-III	**SPECIAL FUNCTIONS:** definition –Beta function – Gamma function – evaluation of Beta function – other forms of Beta function – evaluation of Gamma function – other forms of Gamma function – relation between Beta and Gamma functions – simple problems.
UNIT-IV	**FROBENIUS METHOD AND SPECIAL FUNCTIONS:**singular points of second order linear differential equations and importance – singularities of Bessels and Laguerre equations, Frobenius method and applications to differential equations: Legendre and Hermite differential equations – Legendre and Hermite polynomials – Rodrigues formula –generating function – orthogonality
UNIT-V	**PARTIAL DIFFERENTIAL EQUATIONS:** solutions to partial differential equations using separation of variables - Laplace's equation in problems of rectangular – cylindrical and spherical symmetry – conducting and dielectric sphere in an external uniform electric field – wave equation and its solution for vibrational modes of a stretched string
TEXT BOOKS	1. Mathematical Physics, B.D. Gupta-Vikas Publishing House, 4 th Edition (2006) 2. Mathematical Physics, SatyaPrakash (Sultan Chand)
REFERENCE BOOKS	1. Mathematical Methods for Physicists, G.B.Arfken, H.J.Weber, F.E.Harris (2013, 7th Edn., Elsevier) 2. Mathematical Physics–H. K. Dass, Dr. Rama Verma (S. Chand Publishing) 3. Advanced Engineering Mathematics, Erwin Kreyszig (Wiley India) 4. Mathematical Physics and Special Relativity, M. Das, P.K. Jena and B.K. Dash (Srikrishna Prakashan)

METHOD OF EVALUATION:

Continuous InternalAssessment	End Semester Examination	Total	Grade
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NUMERICAL METHODS AND C PROGRAMMING	
Learning Objective: To understand the methods in numerical differentiation and integration and to develop the problem solving skills of the student. To introduce and explain the basic structure, rules of compiling and execution of C programming.	
UNITS	**COURSE DETAILS**
UNIT-I	**NUMERICAL SOLUTIONS:** determination of zeros of polynomials – roots of linear and nonlinear algebraic and transcendental equations – bisection and Newton-Raphson methods – convergence and divergence of solutions
UNIT-II	**NUMERICAL DIFFERENTIATION, INTEGRATION AND CURVE FITTING:** Newton's forward and backward interpolation – Lagrange's interpolation – Newton-Raphson method to find square root and cube roots – principle of least squares – fitting a straight line and exponential curve – trapezoidal rule – Simpson's 1/3 and 1/8 rule
UNIT-III	**ALGORITHM, FLOW CHART AND PROGRAM:** development of algorithm – flow chart for solving simple problems– average of set of numbers – greatest, smallest – conversion of Fahrenheit to Celsius and Celsius to Kelvin, miles to kilometer – sorting set of numbers in ascending and descending order – square matrix, addition, subtraction and multiplication of order (2x2) using arrays.
UNIT-IV	**INTRODUCTION TO C:** importance of C – basic structure of C programming – constants, variables and data types – character set, key words and identifiers – declaration of variables and data types – operators – expressions: arithmetic, relational, logical, assignment – increment and decrement – conditional – comma operators
UNIT-V	**CONTROL STRUCTURE:** decision making with if, if-else, nested if – switch –go to – break – continue –while, do while, for statements – arrays, one dimensional and two dimensional – declaring arrays – storing arrays in memory –initializing arrays – simple programs
TEXT BOOKS	1. Numerical methods, Singaravelu, Meenakshipublication,4th Edn., 1999. 2. Numerical methods P.Kandasamy, K.Thilagavathy, K. Gunavathi, S.Chand, 2016 3. Programming in C, Balagurusamy, TMG, ND, 2012 4. Numerical Analysis,,M.K.Venkatraman, NPH, 2013 **5.** Numerical Analysis, B.D.Gupta, Konark Publishers, New Delhi, 2013
REFERENCE BOOKS	1. Schaum's outline series, Theory and Problems of programming in C, C.Byronand S. Gottfried, Tata McGraw Hill 2003 3. Numerical methods and C Programming, Veerarajan, 2015.

METHOD OF EVALUATION:

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MATERIALS SCIENCE	
Learning Objective: To learn imperfections in crystals, deformation of materials and testing of materials. To get knowledge on behavior of a material, under the action of light and their applications. To know the applications of crystal defects.	
UNITS	**COURSE DETAILS**
UNIT-I	**CRYSTAL IMPERFECTIONS:** introduction – point defects: vacancies**(***problems***)**, interstitials, impurities, electronic defects – equilibrium concentration of point imperfections **(***problems***)**– application of point defects –line defects: edge dislocation**(***problems***)**, screw dislocation – surface defects: extrinsic defects – intrinsic defects: grain boundaries, tilt andtwist boundaries,twin boundaries, stacking faults – volume defects – effect of imperfections.
UNIT-II	**MATERIAL DEFORMATION: i**ntroduction – elastic behavior of materials – atomic model of elastic behavior –modulus as a parameter in design – rubber like elasticity – inelastic behavior of materials – relaxation process – viscoelastic behavior of materials – spring-Dash pot models of viscoelastic behavior of materials.
UNIT-III	**PERMANENT DEFORMATION AND STRENGTHENING METHODS OF MATERIALS:** introduction –plastic deformation: tensile stress-strain curve – plastic deformation by slip – creep: mechanism of creep – creep resistant materials – strengthening methods: strain hardening, grain refinement – solid solution strengthening – precipitation strengthening.
UNIT-IV	**OPTICAL MATERIALS:** introduction – optical absorption in metals, semiconductors and insulators – NLO materials and their applications – display devices and display materials: fluorescence and phosphorescence – light emitting diodes –liquid crystal displays.
UNIT-V	**MECHANICAL TESTING:** destructive testing: tensile test,compression test, hardness test – nondestructive testing (NDT): radiographic methods, ultrasonic methods – thermal methods of NDT: thermography – equipment used for NDT: metallurgical microscope
TEXT BOOKS	1. Material science and Engineering, Raghavan V, Prentice Hall of India, Sixth Edition, 2015 2. Materials science, V. Rajendran, McGraw Hill publications 2011
REFERENCE BOOKS	1. William D. Callister, Jr., Material Science and Engineering – An Introduction, 8th Edition, John Wiley and Sons, Inc., 2007 2. W. Bolton, "Engineering materials technology", 3rd Edition, Butterworth and Heinemann, 2001. 3. Donald R. Askeland, Pradeep P. Phule, "The Science and Engineering of Materials", 5th Edition, Thomson Learning, First Indian Reprint, 2007. 8. William F. Smith, "Structure and Properties of Engineering Alloys", Mc-Graw-Hill Inc., U.S.A, 2nd edition, 1993.

METHOD OF EVALUATION:

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25	**75**	**100**	

LASERS AND FIBER OPTICS	
Learning Objective: The students will learn the fundamentals, types of lasers, laser instrumentation and their applications also the inter connect between optics with lasers.	
UNITS	**COURSE DETAILS**
UNIT-I	**FUNDAMENTALS OF LASER:** basic principles: spontaneous and stimulated emission – Einstein's coefficient – pumping mechanism: optical, electrical and laser pumping – population inversion – two and three level laser system – resonator configuration – quality factor – threshold condition – concept of Qswitching – Theory of model ocking – cavity dumping.
UNIT-II	**TYPES OF LASER: s**olid state laser: ruby laser, Nd:YAGlaser, Nd:Glasslaser– semiconductor laser: intrinsic semiconductor laser, doped semiconductorlaser, injection laser – dye laser – chemical laser: HCL laser, DF- CO_2, CO chemical laser. Gaslaser:neutral atom gas laser (He-Ne laser), CO_2laser, Copper vapour laser.
UNIT-III	**APPLICATIONS OF LASER:** application of laser in metrology – optical communication – materialprocessing: laser instrumentation of material processing, powder feeder, laser heating, laser welding, laser melting – medical application – Laserinstrumentationforsurgeries– laserinastronomy
UNIT-IV	**FIBEROPTICS:** basic components of optical fiber communication – principles of lightpropagation through fiber – total internal reflection – optical fiber – coherent bundle – numerical aperture and skew mode – phase shift andattenuation during total internal reflection – types of fiber: single mode andmulti-mode fiber – step index and graded index fiber – fiber optic sensors – applicationoffiberoptics.
UNIT-V	**CHARACTERISTICS AND FABRICATION OF OPTICALFIBER:** fiber characteristics: mechanical and transmission characteristics – absorption loss and scattering loss measurements – dispersion – connectors and splicers – fiber termination – optical time domain reflectometer(OTDR) and its uses – fiber material – fiber fabrication – fiber optic cables design.
TEXT BOOKS	1. B.B. Laud - Laser and Non-linear Optics, New Age International Publications Third Edition, New Delhi. 2. An Introduction to laser, theory and applications by Avadhunulu, M.N.S.,Chand and Co, New Delhi 3. J. Wilson and J.F.B. Hawkes. 'Introduction to Opto Electronics', Pearson Education, 2018.
REFERENCE BOOKS	1. A.Sennaroglu,"PhotonicsandLaserEngineering:Principles,Devicesand Applications"McGraw-HillEducation,2010. 2. K.R.Nambiar, "Lasers: Principles, Types and Applications", New Age International, 2004. 3. Optic, AjoyGhatak, McGraw-Hill Education (India) Pvt, Ltd, 6th Edn., 2017.

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DIGITAL PHOTOGRAPHY	
Learning Objective: To understand the principles of photography and image formation and the science and arts behind it. To understand the essential components of conventional and digital cameras and also the different image processing techniques.	
UNITS	**COURSE DETAILS**
UNIT-I	**PHOTOGRAPHY AND BASIC PRINCIPLE OF IMAGE FORMATION:** principle –chemical route and digital route –light, wavelengths, colours – shadows – light intensity and distance – making light form images –pin-hole images – practical limitations to pin-hole images – lens instead of pin-hole – focal length and image size – imaging of closer subjects.
UNIT-II	**LENSES – CONTROLLING THE IMAGES:** photographic lens – focal length and angle of view **(***problems***)** – focusing movement – aperture and f-numbers **(***problems***)** – depth of field– depth of focus – image stabilization – lenses for digital cameras – lens and camera care
UNIT-III	**CAMERA USING FILMS AND ITS TYPES:** camera and its essential components– shutter – aperture – light measurement – film housing – camera types: view camera– view finder camera – Reflex camera– single lens reflex (SLR) camera
UNIT-IV	**DIGITAL CAMERAS PRINCIPLE AND TYPES:** principle of digital image capturing –comparison of digital and analog picture information – megapixel – grain, noise and pixel density – optical and digital zooming – image stabilizer – bit depth – white balance – colour modes – file formats (TIFF, RAW and JPEG) – storage cards and types – digital cameras: camera phones – compact camera – hybrid camera – digital SLR.
UNIT-V	**THE DIGITAL IMAGE – POSTPRODUCTION:** hardware: computer and its peripherals – software: saving digital file – basic editing: navigating the image – undo/redo/history – crop – rotate – brightness and contrast – colour balance – hue/saturation – dodge/burn – cloning and retouching – removing an element in an image – advanced editing: histogram/levels – curves – selection tools: magic wand – printing digital images: inkjet printer – laser printer – dye sub printer – lambda/light jet printers.
TEXT BOOKS	1. Michel J.Langford , Anna Fox and Richard Sawdon Smith, Basic photography, 9th Edition, , 2010-NL, Focal press, London **2.** Henry Carroll, Read this if you want to take great photographs of people, Laurence King Publishing
REFERENCE BOOKS	1. Mark Galer, Digital Photography in Available Light essential skills, 2006, Focal press, London **2.** Paul Harcourt Davies, The Photographer's practical handbook, 2005, UK PRESS

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NANOSCIENCE AND NANO TECHNOLOGY	
Learning Objective: This course aims to provide an overall understanding of Nanoscience and Nanotechnology and introduces different types of nanomaterials, their properties, fabrication methods, characterization techniques and a range of applications.	
UNITS	**COURSE DETAILS**
UNIT-I	**NANOSCIENCE AND NANOTECHNOLOGY:** nanoscale– nature and nanostructures – nanostructures: 0D, 1D,2D– surface to volume ratio– size effect – excitons – quantum confinement– metal based nanoparticles (metal and metal oxide) – nanocomposites (non-polymer based) – carbon nanostructures – fullerene –SWCNT and MWCNT
UNIT-II	**PROPERTIES OF NANOMATERIALS:** introduction –mechanical behavior –elastic properties – hardness and strength – ductility and toughness –superplastic behavior – optical properties – surface plasmon resonance – electrical properties – dielectric materials and properties – magnetic properties – super paramagnetism – electrochemical properties – properties of CNTs.
UNIT-III	**FABRICATION METHODS AND VACUUM TECHNIQUES:** top-down and bottom-up approaches – electrochemical method – chemical and physical vapour depositions (CVD and PVD) – plasma arc discharge – sputtering – thermal evaporation – pulsed laser deposition – ball milling – lithography: photolithography – e-beam lithography – sol-gel methods – synthesis of CNT.
UNIT-IV	**CHARACTERIZATION TECHNIQUES:** scanning probe microscopy – scanning tunneling microscopy – atomic force microscopy – scanning electron microscopy – transmission electron microscopy –powder XRD method: determination of structure and grain size analysis – UV-visible and photoluminescence spectroscopy.
UNIT-V	**APPLICATIONS OF NANOMATERIALS:** medicine: drug delivery – photodynamic therapy – molecular motors –energy: fuel cells – rechargeable batteries – supercapacitors– photovoltaics. sensors: nanosensors based on optical and physical properties – electrochemical sensors – nanobiosensors. nanoelectronics: CNTFET – display screens – GMR read/write heads – nanorobots –applications of CNTs
TEXT BOOKS	1. K.K.Chattopadhyay and A.N.Banerjee, (2012), Introduction to Nanoscience and Nanotechnology, PHI Learning Pvt. Ltd., 2. M.A. Shah, Tokeer Ahmad (2010), Principles of Nanoscience and Nanotechnology, Narosa Publishing House Pvt Ltd. 3. Mick Wilson, et al (2005) Nanotechnology, Overseas Press.
REFERENCE BOOKS	1. Richard Booker and Earl Boysen, (2005) Nanotechnology, Wiley Publishing Inc. USA 2. J.H.Fendler (2007) Nano particles and nano structured films; Preparation, Characterization and Applications, John Wiley and Sons 3. B.S.Murty, et al (2012) Textbook of Nanoscience and Nanotechnology, Universities Press.

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MEDICAL INSTRUMENTATION	
Learning Objective: This course aims to provide background of the Physics principles inmedical instrumentation technologies through theoretical and practical learning.	
UNITS	**COURSE DETAILS**
UNIT-I	**BIOMETRICS:** introduction to man-instrument system and its components – problems encountered in measuring living systems – transducers– force, motion, pressure transducers. **AUDIOMETRY:** mechanism of hearing – air and bone conduction – threshold of hearing – audiometer – masking in audiometry – pure tone and speech audiometer – evoked response audiometry – hearing aids
UNIT-II	**BIOELECTRIC POTENTIALS AND ELECTRODES:** biomedical signals – sources of bioelectric potentials – resting, action and propagation of bioelectric potentials –bio-potential electrodes – skin surface, needle electrodes. **BIOMEDICAL RECORDERS:** electro-conduction system of heart – electro cardiogram (ECG) – Einthoven's triangle — electro encephalogram (EEG) –brain waves – EEG instrumentation – recording of evoked potentials – electro myogram (EMG)–pulse oximeter.
UNIT-III	**DIAGNOSTIC RADIOLOGY:** radiography – primary radiological image – contrast agents, filters – beam restrictor, grid – image quality **COMPUTED TOMOGRAPHY:** linear tomography – computed tomography – helical and multi slice – image quality– radiation dose. **RADIOISOTOPES AND NUCLEAR MEDICINE:** radioisotopes – radiopharmaceuticals – technetium generator – gamma camera – positron emission tomography – disposal of radioactive waste.
UNIT-IV	**ULTRASOUND IMAGING:** ultrasound transducer – ultrasound imaging– Doppler ultrasound – ultrasound image quality and bio-effects. **MAGNETIC RESONANCE IMAGING:**proton and external magnetic field – precession – radiofrequency and resonance – MRI signal – relaxation time – MRI instrumentation – imaging sequences – biosafety
UNIT-V	**PROJECT ASSIGNMENT:** clinical practice of *one* of the following: electro cardiogram, electro encephalogram, electro myogram, electro oculogram, computed tomography, positron emission tomography, ultrasound
TEXT BOOKS	1. Leslie Cromwell, Fred Weibell, Erich Pfieffer (2002) Biomedical Instrumentation and Measurements Prentice Hall of India, New Delhi. 2. R. S. Khandpur (2003) Handbook of Biomedical Instrumentation 2nd Edn. Tata McGraw Hill, New Delhi. 3. Kuppusamy Thayalan (2017), Basic Radiological Physics 2nd Edn. Jaypee Brothers Medical Publishers (P) Ltd, New Delhi.
REFERENCE BOOKS	1. John Webster (2004) Bioinstrumentation John Wiley and Sons, Singapore. 2. John Enderle, Susan Blanchard, Joseph Bronzino (2005) Introduction to Biomedical Engineering, 2nd ed. Elsevier, San Deigo 3. William Hendee, Geoffrey Ibbott, Eric Hendee (2005) Radiation therapy Physics 3rd ed. Wiley-Liss, New Jersey

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LIST OF NON MAJOR ELECTIVES (NME)

PHYSICS FOR EVERYDAY LIFE	
Learning Objective: To know where all physics principles have been put to use in daily life and appreciate the concepts with a better understanding also to know about Indian scientists who have made significant contributions to Physics	
UNITS	**COURSE DETAILS**
UNIT-I	**MECHANICAL OBJECTS: s**pring scales – bouncing balls –roller coasters – bicycles –rockets and space travel.
UNIT-II	**OPTICAL INSTRUMENTS AND LASER:** vision corrective lenses – polaroid glasses – UV protective glass – polaroid camera – colour photography – holography and laser.
UNIT-III	**PHYSICS OF HOME APPLIANCES:** bulb – fan – hair drier – television – air conditioners – microwave ovens – vacuum cleaners
UNIT-IV	**SOLAR ENERGY:** Solar constant – General applications of solar energy – Solar water heaters – Solar Photo – voltaic cells – General applications of solar cells.
UNIT-V	**INDIAN PHYSICIST AND THEIR CONTRIBUTIONS:** C.V.Raman, Homi Jehangir Bhabha, Vikram Sarabhai, Subrahmanyan Chandrasekhar, Venkatraman Ramakrishnan, Dr. APJ Abdul Kalam and their contribution to science and technology.
TEXT BOOKS	1. The Physics in our Daily Lives, UmmeAmmara, GugucoolPublishing, Hyderabad, 2019. 2. For the love of physics, Walter Lawin, Free Press, New York, 2011.

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ASTROPHYSICS	
Learning Objective: This course intends to introduce principles of astrophysics describing the science of formation and evolution of stars and interpretation of various heavenly phenomena and provide an understanding of the physical nature of celestial bodies along with the instrumentation and techniques used in astronomical research	
UNITS	**COURSE DETAILS**
UNIT-I	**TELESCOPES:** Optical telescopes – magnifying power, brightness, resolving power and f/a ratio – types of reflecting and refracting telescopes – detectors and image processing – radio telescopes – Hubble space telescope.
UNIT-II	**SOLAR SYSTEM:** Bode's law of planetary distances – meteors, meteorites, comets, asteroids – Kuiper belt – Oort cloud – detection of gravitational waves – recent advances in astrophysics.
UNIT-III	**ECLIPSES:** types of eclipses – solar eclipse – total and partial solar eclipse – lunar eclipse – total and partial lunar eclipse – transits. **THE SUN:** physical and orbital data – solar atmosphere – photosphere – chromosphere – solar corona – prominences – sunspots – 11year solar cycle – solar flares.

UNIT-IV	**STELLAR EVOLUTION:** H-R diagram – birth and death of low mass, intermediate mass and massive stars – Chandrasekar limit – white dwarfs – neutron stars – pulsars – black holes – supernovae. **GALAXIES:** classification of galaxies – galaxy clusters –interactions of galaxies, dark matter and super clusters – evolving universe.
UNIT-V	**ACTIVITIES IN ASTROPHYSICS:** (i) Basic construction of telescope (ii) Develop models to demonstrate eclipses/planetary motion (iii) Night sky observation (iv) Conduct case study pertaining to any topic in this paper (v) Visit to any one of the National Observatories Any three activities to be done compulsorily.
TEXT BOOKS	1. BaidyanathBasu, (2001). An introduction to Astrophysics, Second printing, Prentice – Hall of India (P) Ltd, New Delhi 2. K.S.Krishnaswamy, (2002), Astrophysics – a modern perspective, New Age International (P) Ltd, New Delhi. 3. Shylaja, B.S. andMadhusudan, H.R.,(1999), Eclipse: A Celestial Shadow Play, Orient BlackSwan,

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
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PHYSICS OF MEDICAL INSTRUMENTS	
Learning Objective: The students will be exposed to instruments like ECG,EEG,EMG, medical imaging, diagnostic specialties, operation theater and its safety which will kindle interest to specialize in instrument servicing.	
UNITS	**COURSE DETAILS**
UNIT-I	**BIO-POTENTIALS AND ELECTRODES:** transport of ions through cell membrane- resting and action potential - Characteristics of resting potential – bio-electric potential – design of medical instruments – components of bio-medical instrumentation – electrodes – electrode potential – metal microelectrode – depth and needle electrodes – types of surface electrode – the pH electrode.
UNIT-II	**Bio-potential based Instrumentation:** Electrocardiography (ECG) – origin of cardiac action potential - ECG lead configuration –block diagram of ECG recording set up (qualitative) – Electroencephalography (EEG) – origin of EEG – action and evoked potentials - brain waves – block diagram of modern EEG set up – electromyography (EMG) – block diagram of EMG recording setup.
UNIT-III	**OPERATION THEATRE AND SAFETY:** diathermy – block diagram of the electrosurgical diathermy– shortwave, microwave, ultrasonic diathermy – ventilators – servo controlled systems – **RADIATION SAFETY:** units of radiation - pocket dosimeter – pocket type radiation alarm – thermo-luminescence dosimeter.

UNIT-IV	**MEDICAL IMAGING:** nuclear imaging technique –computer tomography (CT) – principle – mathematical basis of image construction –block diagram of CT scanner – ultrasonic imaging systems – construction of transducer – display modes – MRI principle and instrumentation.
UNIT-V	**DIAGNOSTICS AND SPECIALITIES:**X-rays in radiography – fluoroscopy – comparison– image intensifiers – angiography – applications of X-ray examination (*problems*). **LASER IN MEDICINE:** laser interactions with biomolecules – advantages of laser surgery – endoscopy – types of endoscopes with their operation (qualitative).
TEXT BOOKS	1. Biomedical Instrumentation and measurement, Leslie Cromwell, PHI, 2015 2. Medical Instrumentation, M. Arumugam, Anuradha agencies, 1992 3. Medical Electronics, M.J.Kumar Doss, Prathibha Publishers, 1987 4. Medical Physics, John R. Cameron and James G. Skofronick, Thrift books, Atlanta, 1985 5. Electronic Instruments and Instrumentation Technology, M. M.M.Anand, PHI, 2015

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HOME ELECTRICAL INSTALLATION	
Learning Objective: The students will get knowledge on electrical instruments, installations and domestic wiring techniques with safety precautions and servicing.	
UNITS	**COURSE DETAILS**
UNIT-I	**SIMPLE ELECTRICAL CIRCUITS: c**harge, current, potential difference, resistance – simple electrical circuits – DC ammeter, voltmeter, ohmmeter – Ohm's law – difference between DC and AC – advantages of AC over DC – electromagnetic induction - transformers – inductors/chokes – capacitors/condensers – impedance – AC ammeter, voltmeter –symbols and nomenclature
UNIT-II	**TRANSMISSION OF ELECTRICITY:** production and transmission of electricity – concept of power grid – Series and parallel connections – technicalities of junctions and loops in circuits –transmission losses (qualitative) – roles of step-up and step-down transformers – quality of connecting wires – characteristics of single and multicore wires
UNIT-III	**ELECTRICAL WIRING:** different types of switches – installation of two way switch – role of sockets, plugs, sockets - installation of meters – basic switch board – electrical bell – indicator – fixing of tube lights and fans – heavy equipment like AC, fridge, washing machine, oven, geyser, jet pumps – provisions for inverter – gauge specifications of wires for various needs
UNIT-IV	**POWER RATING AND POWER DELIVERED:** conversion of electrical energy in to different forms – work done by electrical energy

	– power rating of electrical appliances – energy consumption – electrical energy unit in kWh – calculation of EB bill – Joule's heating – useful energy and energy loss – single and three phase connections – Measures to save electrical energy – energy audit
UNIT-V	**SAFETY MEASURES:** insulation for wires – colour specification for mains, return and earth – Understanding of fuse and circuit breakers – types of fuse: kit-kat, HRC, cartridge, MCB, ELCB – purpose of earth line – lighting arrestors – short circuiting and over loading – electrical safety – tips to avoid electrical shock – first aid for electrical shock – fire safety for electric current
TEXT BOOKS	1. Wiring a House: 5th Edition by Rex Cauldwell, (2014). 2. Black and Decker Advanced Home Wiring, 5th Edition: Backup Power - Panel Upgrades - AFCI Protection - "Smart" Thermostats, by Editors of Cool Springs Press, (2018). 3. Complete Beginners Guide to Rough in Electrical Wiring: by Kevin Ryan (2022).

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PHYSICS OF MUSIC	
Learning Objective: To apprise and train students on the role of Physics in music and get the knowledge on the musical notes and instruments.	
UNITS	**COURSE DETAILS**
UNIT-I	**SCIENTIFIC STUDY OF MUSIC:** vibrations of atoms of matter– vibrations coupling to air – propagation of sound waves in air, other media, fluids and solids – velocity, frequency, wavelength, time period, intensity: definition and unit fs – classification of sound on frequency and velocity– human and animal sound perception– mechanism of ear and hearing – psychoacoustics
UNIT-II	**SIMPLE VIBRATING SYSTEMS:** simple harmonic motion – tuning fork– amplitude, phase, energy, energy loss/damping/ dissipation – power – travelling waves and standing waves– laws of vibration in stretched strings– one-dimensional medium – open and closed organ pipes – over tones, harmonics – quality of sound: pitch, timber, loudness – octaves, musical notes
UNIT-III	**MUSICAL TONE:** pure/simple tones – sine/cosine waves– well-defined frequencies, wavelengths, amplitudes and phases– partial tones – assembly of pure tones– mix of different frequencies and amplitudes– complex tone – superposition of simple tones – complex waveform– periodic complex waveform – formants – resonances– sound envelope
UNIT-IV	**PRODUCTION OF MUSICAL SOUNDS:** human voice, mechanism of vocal sound production – larynx (sound box) – *stringed Instruments*: plucked and bowed, guitar, mandolin, violin, piano, etc. – *wind instruments*: whistles, flute, saxophone, pipe organ, bagpipes,

	etc– *percussion instruments*: plates, membranes, drums, cymbals, xylophone etc. – *electronic instruments*: keyboards, electric guitars, rhythm pads, etc. – analog and digital sound synthesizers,–MIDI instrument– computer generated music
UNIT-V	**RECORDING OF MUSIC and SOUND:** Edison phonograph – cylinder and disk records – magnetic wire and tape recorders – digital recording (e.g. to CD, DVD, etc.)– analog transducers, condenser, dynamic microphones, loudspeaker – complex sound fields – near and far fields of acoustic– spectral analysis techniques – continuous and discrete Fourier transforms, digital signal processing – digital filtering – specifications of recording studios
TEXT BOOKS	1. Physics and Music: The Science of Musical Sound by Harvey White (2014) 2. Good Vibrations – The Physics of Music by Barry Parker, (2009) 3. The History of Musical Instruments by Curt Sachs, (2006) 4. Physics and Music: Essential Connections and Illuminating Excursions by Kinko Tsuji and Stefan C. Müller (2021)

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

COURSE	**ALLIED PAPER**
COURSETITLE	**ALLIED PHYSICS – I**
CREDITS	3
COURSE OBJECTIVES	To impart basicprinciplesof Physics that which would be helpful for students who have taken programmes other than Physics.

UNITS	COURSE DETAILS
UNIT-I	**WAVES, OSCILLATIONS AND ULTRASONICS:** simple harmonic motion (SHM) – composition of two SHMs at right angles (periods in the ratio 1:1) – Lissajous figures – uses – laws of transverse vibrations of strings – determination of AC frequency using sonometer (steel and brass wires) – ultrasound – production – piezoelectric method – application of ultrasonics: medical field – lithotripsy, ultrasonography –ultrasonoimaging- ultrasonics in dentistry – physiotheraphy, opthalmology – advantages of noninvasive surgery – ultrasonics in green chemistry.
UNIT-II	**PROPERTIES OF MATTER:** *Elasticity*: elastic constants – bending of beam – theory of non- uniform bending – determination of Young's modulus by non-uniform bending – energy stored in a stretched wire – torsion of a wire – determination of rigidity modulus by torsional pendulum *Viscosity*: streamline and turbulent motion – critical velocity – coefficient of viscosity – Poiseuille's formula – comparison of viscosities – burette method, *Surface tension*: definition – molecular theory – droplets formation– shape, size and lifetime – COVID transmission through droplets, saliva – drop weight method – interfacial surface tension.
UNIT-III	**HEAT AND THERMODYNAMICS:** Joule-Kelvin effect – Joule-Thomson porous plug experiment – theory – temperature of inversion – liquefaction of Oxygen– Linde's process of liquefaction of air– liquid Oxygen for medical purpose– importance of cryocoolers– thermodynamic system – thermodynamic equilibrium – laws of thermodynamics – heat engine – Carnot's cycle – efficiency – entropy – change of entropy in reversible and irreversible process.
UNIT-IV	**ELECTRICITY AND MAGNETISM:** potentiometer – principle – measurement of thermo emf using potentiometer –magnetic field due to a current carrying conductor – Biot-Savart's law – field along the axis of the coil carrying current – peak, average and RMS values of ac current and voltage – power factor and current values in an AC circuit – types of switches in household and factories– Smart wifi switches-fuses and circuit breakers in houses
UNIT-V	**DIGITAL ELECTRONICS AND DIGITAL INDIA:** logic gates, OR, AND, NOT, NAND, NOR , EXOR logic gates – universal building blocks – Boolean algebra – De Morgan's theorem – verification – overview of Government initiatives: software technological parks under MeitY, NIELIT- semiconductor laboratories under Dept. of Space – an introduction to Digital India

UNIT-VI	**PROFESSIONAL COMPONENTS:**expert lectures –seminars — webinars – industry inputs – social accountability – patriotism
TEXT BOOKS	1. R.Murugesan (2001), Allied Physics,S. Chand and Co,NewDelhi. 2. Brijlal and N.Subramanyam (1994), Waves and Oscillations, Vikas Publishing House, NewDelhi. 3. Brijlal and N.Subramaniam (1994), Properties of Matter, S.Chand andCo.,NewDelhi. 4. J.B.Rajam and C.L.Arora (1976). Heat and Thermodynamics (8^{th} edition), S.Chand andCo.,New Delhi. 5. R.Murugesan(2005), Optics and Spectroscopy, S.Chand and Co,NewDelhi. 6. A.Subramaniyam, Applied Electronics 2^{nd}Edn.,National Publishing Co., Chennai.
REFERENCE BOOKS	1. Resnick Halliday and Walker(2018). Fundamentals of Physics (11^{th}edition), John Willey and Sons, Asia Pvt.Ltd., Singapore. 2. V.R.Khannaand R.S.Bedi (1998), Text book of Sound1^{st}Edn. Kedharnaath Publishand Co, Meerut. 3. N.S.Khare and S.S.Srivastava (1983), Electricity and Magnetism10^{th}Edn.,Atma Ram and Sons, New Delhi. 4. D.R.KhannaandH.R. Gulati(1979). Optics, S. Chand and Co.Ltd., New Delhi. **5.** V.K.Metha (2004). Principles of electronics 6^{th}Edn. S.Chand and company.
WEB RESOURCES	1. https://youtu.be/M_5KYncYNyc 2. https://youtu.be/ljJLJgIvaHY 3. https://youtu.be/7mGqd9HQ_AU 4. https://youtu.be/h5jOAw57OXM 5. https://learningtechnologyofficial.com/category/fluid-mechanics-lab/ 6. http://hyperphysics.phy-astr.gsu.edu/hbase/permot2.htmlhttps://www.youtube.com/watch?v=gT8Nth9NWPMhttps://www.youtube.com/watch?v=9mXOMzUruMQandt=1shttps://www.youtube.com/watch?v=m4u-SuaSu1sandt=3shttps://www.biolinscientific.com/blog/what-are-surfactants-and-how-do-they-work

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

COURSE OUTCOMES:
At the end of the course, the student will be able to:

COURSEOUTCOMES	**CO1**	Explain types of motion and extend their knowledge in the study of various dynamic motions analyze and demonstrate mathematically. Relate theory with practical applications in medical field.
	CO2	Explain their knowledge of understanding about materials and their behaviors and apply it to various situations in laboratory and real life. Connect droplet theory with Corona transmission.
	CO3	Comprehend basic concept of thermodynamics concept of entropy and associated theorems able to interpret the process of flow temperature physics in the background of growth of this technology.
	CO4	Articulate the knowledge about electric current resistance, capacitance in terms of potential electric field and electric correlate the connection between electric field and magnetic field and analyze them mathematically verify circuits and apply the concepts to construct circuits and study them.
	CO5	Interpret the real life solutions using AND, OR, NOT basic logic gates and intend their ideas to universal building blocks. Infer operation using Boolean algebra and acquire elementary ideas of IC circuits. Acquire information about various Govt. programs/ institutions in this field.

MAPPING WITH PROGRAM OUT COMES:

Mapcourseoutcomes**(CO)**foreachcoursewithpogramoutcomes**(PO)**inthe3-pointscaleofSTRONG(**S**),MEDIUM(**M**)andLOW(**L**).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	S	S	S
CO2	M	S	S	S	M	S	S	S	S	M
CO3	M	S	S	S	S	M	S	S	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	M	S	S	S	S	S	S	S	S	S

COURSE	**ODD SEMESTER - CORE**
COURSETITLE	**ALLIED PRACTICAL– I**
CREDITS	2
COURSE OBJECTIVES	Apply various physics concepts to understand Properties of Matter and waves, set up experimentation to verify theories, quantify and analyse, able to do error analysis and correlate results

Minimum of Ten Experiments from the list:

1. Young's modulus by non-uniform bending using pin and microscope
2. Young's modulus by non-uniform bending using optic lever, scale and telescope
3. Rigidity modulus by static torsion method.
4. Rigidity modulus by torsional oscillations without mass
6. Surface tension and interfacial Surface tension – drop weight method
7. Comparison of viscosities of two liquids – burette method
8. Specific heat capacity of a liquid – half time correction
9. Verification of laws of transverse vibrations using sonometer
10. Calibration of low range voltmeter using potentiometer
11. Determination of thermo emf using potentiometer
12. Verification of truth tables of basic logic gates using ICs
13. Verification of De Morgan's theorems using logic gate ICs.
14. Use of NAND as universal building block.
15. Any other practicals

Note : Use of digital balance permitted

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

COURSE	**ALLIED PAPER**
COURSETITLE	**ALLIED PHYSICS –II**
CREDITS	3
COURSE OBJECTIVES	To understand the basic concepts of optics, modern Physics, concepts of relativity and quantum physics, semiconductor physics, and electronics.

UNITS	COURSE DETAILS
UNIT-I	**OPTICS: i**nterference – interference in thin films –colors of thin films – air wedge – determination of diameter of a thin wire by air wedge – diffraction – diffraction of light vs sound – normal incidence – experimental determination of wavelength using diffraction grating (no theory) – polarization – polarization by double reflection – Brewster's law – optical activity – application in sugar industries
UNIT-II	**ATOMIC PHYSICS:** atom models – Bohr atom model – mass number – atomic number – nucleons – vector atom model – various quantum numbers – Pauli's exclusion principle – electronic configuration – periodic classification of elements – Bohr magneton – Stark effect –Zeeman effect (elementary ideas only) – photo electric effect – Einstein's photoelectric equation – applications of photoelectric effect: solar cells, solar panels, optoelectric devices
UNIT-III	**NUCLEAR PHYSICS:** nuclear models – liquid drop model – magic numbers – shell model – nuclear energy – mass defect – binding energy – radioactivity – uses – half life – mean life - radio isotopes and uses –controlled and uncontrolled chain reaction – nuclear fission – energy released in fission – chain reaction – critical reaction – critical size- atom bomb – nuclear reactor – breeder reactor – importance of commissioning PFBR in our country – heavy water disposal, safety of reactors: seismic and floods –introduction to DAE, IAEA – nuclear fusion – thermonuclear reactions – differences between fission and fusion.
UNIT-IV	**INTRODUCTION TO RELATIVITY AND GRAVITATIONAL WAVES**: frame of reference – postulates of special theory of relativity – Galilean transformation equations – Lorentz transformation equations – derivation – length contraction – time dilation – twin paradox – mass-energy equivalence –introduction on gravitational waves, LIGO, ICTS opportunities at International Centre for Theoretical Sciences
UNIT-V	**SEMICONDUCTOR PHYSICS:** p-n junction diode – forward and reverse biasing – characteristic of diode – zener diode – characteristic of zener diode – voltage regulator – full wave bridge rectifier – construction and working – advantages (no mathematical treatment) – USB cell phone charger –introduction to e-vehicles and EV charging stations

UNIT-VI	**PROFESSIONAL COMPONENTS:** expert lectures –seminars – – webinars – industry inputs – social accountability – patriotism
TEXT BOOKS	1. R.Murugesan (2005), Allied Physics, S.Chand and Co,NewDelhi. 2. K.Thangaraj and D.Jayaraman (2004), Allied Physics, Popular BookDepot,Chennai. 3. Brijlal and N.Subramanyam (2002), Text book of Optics, S.Chand and Co,NewDelhi. 4. R.Murugesan (2005), Modern Physics, S.Chand and Co,New Delhi. 5. A.Subramaniyam Applied Electronics, 2nd Edn.,National PublishingCo.,Chennai.
REFERENCE BOOKS	1. Resnick Halliday and Walker (2018), Fundamentals of Physics, 11th Edn., John WilleyandSons, Asia Pvt.Ltd., Singapore. 2. D.R.Khanna and H.R. Gulati (1979).Optics, S.Chand and Co.Ltd.,New Delhi. 3. A.Beiser (1997), Concepts of Modern Physics, Tata McGraw Hill Publication, NewDelhi. 4. Thomas L. Floyd (2017), Digital Fundamentals, 11th Edn., Universal Book Stall, NewDelhi. 5. V.K.Metha(2004), Principles of electronics, 6th Edn. ,S.Chand and Company, New Delhi.
WEB RESOURCES	1. https://www.berkshire.com/learning-center/delta-p-facemask/https://www.youtube.com/watch?v=QrhxU47gtj4https://www.youtube.com/watch?time_continue=318andv=D38BjgUdL5Uandfeature=emb_logo 2. https://www.youtube.com/watch?v=JrRrp5F-Qu4 3. https://www.validyne.com/blog/leak-test-using-pressure-transducers/ 4. https://www.atoptics.co.uk/atoptics/blsky.htm - 5. https://www.metoffice.gov.uk/weather/learn-about/weather/optical-effects

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

COURSE OUTCOMES:
At the end of the course, the student will be able to:

COURSE OUTCOMES	**CO1**	Explain the concepts of interference diffraction using principles of superposition of waves and rephrase the concept of polarization based on wave patterns
	CO2	Outline the basic foundation of different atom models and various experiments establishing quantum concepts. Relate the importance ofinterpretingimprovingtheoreticalmodelsbasedonobservation.Appreciateinterdisciplinarynatureofscience and in solar energy related applications.
	CO3	Summarize the properties of nuclei, nuclear forces structure of atomic nucleus and nuclear models. Solve problems on delay rate half-life and mean-life. Interpret nuclear processes like fission and fusion. Understand the importance of nuclear energy, safety measures carried and get our Govt. agencies like DAE guiding the country in the nuclear field.
	CO4	To describe the basic concepts of relativity like equivalence principle, inertial frames and Lorentz transformation. Extend their knowledge on concepts of relativity and vice versa. Relate this with current research in this field and get an overview of research projects of National and International importance, like LIGO, ICTS, and opportunities available.
	CO5	Summarize the working of semiconductor devices like junction diode, Zener diode, transistors and practical devices we daily use like USB chargers and EV charging stations.

MAPPING WITH PROGRAM OUT COMES:
Map course outcomes **(CO)** for each course with program outcomes **(PO)** in the 3-point scale of STRONG(**S**), MEDIUM(**M**) and LOW(**L**).

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	M	S	S	S	M	S	S	S	S	M
CO3	M	S	S	S	S	M	S	S	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	M	S	S	S	S	S	S	S	S	S

COURSE	**EVEN SEMESTER - CORE**
COURSETITLE	**ALLIED PRACTICAL– II**
CREDITS	2
COURSE OBJECTIVES	Apply various Physics concepts to understand concepts of Light, electricity and magnetism and waves, set up experimentation to verify theories, quantify and analyse, able to do error analysis and correlate results

Minimum of Ten Experiments from the list:

1. Radius of curvature of lens by forming Newton's rings
2. Thickness of a wire using air wedge
3. Wavelength of mercury lines using spectrometer and grating
4. Refractive index of material of the lens by minimum deviation
5. Refractive index of liquid using liquid prism
6. Determination of AC frequency using sonometer
7. Specific resistance of a wire using PO box
8. Thermal conductivity of poor conductor using Lee's disc
9. Determination of figure of merit table galvanometer
10. Determination of Earth's magnetic field using field along the axis of a coil
11. Characterisation of Zener diode
12. Construction of Zerner/IC regulated power supply
13. Construction of AND, OR, NOT gates using diodes and transistor
14. NOR gate as a universal building block

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

LIST OF SKILL ENHANCEMENT COURSE (INCLUDES ENTREPRENEURIAL BASED)

Plotting Skills	
Learning Objective: To get a feel for the functions in various courses of the Physics through use of mobile apps.	
UNITS	**COURSE DETAILS**
UNIT-I	Plotting Trigonometric functions
UNIT-II	Plotting Polynomial and finding roots
UNIT-III	Plotting Solutions of differential equations
UNIT-IV	Plotting logarithmic and exponential functions
UNIT-V	Plotting solutions of the Problems in Mechanics
Reference	1. Functions and their Graphs, Jackie Nicholas, Janet Hunter and Jacqui Hargreaves, (1999) University of Sydney 2. Play with Graphs, Amit M. Aggarwal, Arihant Publishers, (2018) 3. Introduction Mechanics for Engineers, Andy Ruina and Rudra Pratap, Preprint for Springer (2019) 4. Calculus, James Stewart, Thomson (2008) Sixth Edition 5. Help files of the apps.

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

Introduction to Python Programming	
Learning Objective: To understand a high level overview of programming and the tools needed to develop android applications.	
UNITS	**COURSE DETAILS**
UNIT-I	Installing Python – Program with variables - Library functions - Importingfrom modules and packages - plotting, printing and input data
UNIT-II	Python interaction – variables, objects and Expressions, numerical arrays – Random numbers
UNIT-III	For loop – while loop – branching; if, elesif and else
UNIT-IV	Function writing - Programming as a step-wise strategy
UNIT-V	List and tuples – exception handling – symbolic computation – making module – Apply to oscillating 1D system – simple model and numerical simulation
TEXT BOOKS	1. Programming for Computations – Python , Svein Linge and Hans Petter Langtangen, Spiringer Open (2020), Second Edition **2.** Introduction to Python Programming for Undergraduate Physics, Santu Chakraborty, New Academic Publishers (2020), First Edition

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

Introduction to Android Mobile Application Development	
Learning Objective: To understand a high level overview of programming and the tools needed to develop android applications.	
UNITS	**COURSE DETAILS**
UNIT-I	**Introduction to Mobile Application Development (6L)** Introduction to this program - Introduction to the course - The mobile developer role - A day in the life of an Android developer - Setting up Android Studio - What is a mobile app? - Mobile apps at Meta What kind of careers are there in Android development?
UNIT-II	**Android languages (6L)** Java vs Kotlin - Android Studio: Take a Tour - Project templates - Starting a project - Anatomy of an Android App - Module summary: Introduction to Mobile Application Development
UNIT-III	**Emulation and Development (6L)** What is an emulator? - Android Virtual Device Manager - Operating System Images - Configuring an emulator - Project structure - Main activity – Gradle - Android manifest - Resource folder - Examination of res folder - Examination of subfolders - Module summary: Emulation and development
UNIT-IV	**Building the app (6L)** Requirements Gathering - Project proposal - Start the project - Setting up the screen - Finding the assets - Required imports
UNIT-V	**Kotlin (6L)** Simple terms - Create the player - Module summary: Building the app - Course recap: Introduction to Android mobile application development
TEXT BOOKS	1. Fundamentals of Android App Development January 2020 by Sujit Kumar Mishra 2. Lean Mobile App Development –28 November 2017 by Mike van Drongelen (Author), Adam Dennis (Author), Richard Garabedian (Author), Alberto Gonzalez (Author), Aravind Krishnaswamy (Author) 3. https://in.coursera.org/learn/introduction-to-android-mobile-application-development

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

Introduction to Web Development
Learning Objective: To learn about basic knowledge and skills required for planning,

designing and developing effective web pages	
UNITS	**COURSE DETAILS**
UNIT-I	**Course Overview and Website Structure and Hosting (5L)** Introduction - What is a Web Hosting Company? - How to Find and Select a Web Hosting Company - Naming a Website - Website Name Registration - Networks and the Internet - First Look at a Website Control Panel - Web Development Tools
UNIT-II	**Designing Your Own Website: HTML Basic (5L)** Introduction - Components and Structure of a Website - Creating Your Own HTML: Setting Up a Template - Creating Your Own HTML: Creating Links and Formatting Text - Creating Your Own HTML: Working with Images - Creating Your Own HTML: Working with Tables - Creating HTML - How to Practice - How to Put Your HTML on the Internet - How to Test Your HTML - Basic Styling in Webpages.
UNIT-III	**Introduction to Programming Using JavaScript (5L)** Introduction - Static vs. Dynamic Webpages - The Value of JavaScript to Our Websites - JavaScript Basics: Fundamental Syntax - Putting JavaScript to Work: Using Alerts and Prompts - Putting Javascript to Work: Events - Putting JavaScript to Work: Gathering Additional User Input and Dynamically Modifying HTML - Testing JavaScript
UNIT-IV	**Websites with Style: CSS Properties, Colors and Fonts (5L)** Introduction - Plain Websites are Boring - CSS Basics - Putting CSS to Work: Getting Started with External CSS - Putting CSS to Work: Setting Colors with CSS - Putting CSS to Work: Controlling Your Page Layout - Putting CSS to Work: Common CSS Properties - How to Practice CSS - Testing Website Styles
UNIT-V	**Creating HTML Forms (5L)** Introduction - HTML Forms User Input - HTML Form Elements - HTML Form Validation: JavaScript - HTML Form Validation: Complex Form Example - HTML Form Validation: Additional Features - HTML Form Validation: Processing. **Creating Web Applications (5L)** Introduction - Client-side versus Server-side Application Development - Features in Web Applications: The While Loop - Features in Web Applications: The for Loop - Creating New Features in Web Applications - Guided Practice with HTML Form Validation - Guided Practice with HTML Form Validation - Course Summary
TEXT BOOKS	1. Web Technologies, Black Book, 2018 by DT Editorial Services 2. A Complete Overview On: Web-development by Ayush Mauryavanshi (2021) 3. https://www.coursera.org/learn/web-development. **4.** https://in.coursera.org/learn/introduction-to-android-mobile-application-development

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

LIST OF SKILL ENHANCEMENT COURSES (DISCIPLINE / SUBJECT SPECIFIC)

PHYSICS WORKSHOP SKILL	
Learning Objective: *The aim of this course is to enable the students to familiar and experience with various mechanical and electrical tools through hands-on mode*	
UNITS	**COURSE DETAILS**
UNIT-I	**Introduction:** Measuring units. conversion to SI and CGS. Familiarization with meter scale, Vernier calliper, Screw gauge and their utility. Measure the dimension of a solid block, volume of cylindrical beaker/glass, diameter of a thin wire, thickness of metal sheet, etc. Use of Sextant to measure height of buildings, mountains, etc. **(4 Lectures)**
UNIT-II	**Mechanical Skill**: Concept of workshop practice. Overview of manufacturing methods: casting, foundry, machining, forming and welding. Types of welding joints and welding defects. Common materials used for manufacturing like steel, copper, iron, metal sheets, composites and alloy, wood. Concept of machine processing, introduction to common machine tools like lathe, shaper, drilling, milling and surface machines. Cutting tools, lubricating oils. Cutting of a metal sheet using blade. Smoothening of cutting edge of sheet using file. Drilling of holes of different diameter in metal sheet and wooden block. Use of bench vice and tools for fitting. Make funnel using metal sheet. **(10 Lectures)**
UNIT-III	**Introduction to Programming Using JavaScript (5L)** Introduction - Static vs. Dynamic Webpages - The Value of JavaScript to Our Websites - JavaScript Basics: Fundamental Syntax - Putting JavaScript to Work: Using Alerts and Prompts - Putting Javascript to Work: Events - Putting JavaScript to Work: Gathering Additional User Input and Dynamically Modifying HTML - Testing JavaScript
UNIT-IV	**Electrical and Electronic Skill**: Use of Multimeter. Soldering of electrical circuits having discrete components (R, L, C, diode) and ICs on PCB. Operation of oscilloscope. Making regulated power supply. Timer circuit, Electronic switch using transistor and relay.
UNIT-V	**Introduction to prime movers**: Mechanism, gear system, wheel, Fixing of gears with motor axel. Lever mechanism, Lifting of heavy weight using lever. braking systems, pulleys, working principle of power generation systems. Demonstration of pulley experiment. **(6 Lectures)**
TEXT BOOKS	1. A text book in Electrical Technology - B L Theraja – S. Chand and Company. 2. Performance and design of AC machines – M.G. Say, ELBS Edn. 3. Mechanical workshop practice, K.C. John, 2010, PHI Learning Pvt. Ltd. 4. Workshop Processes, Practices and Materials, Bruce J Black 2005, 3rd Edn., 5. Editor Newnes [ISBN: 0750660732]

	6. New Engineering Technology, Lawrence Smyth/Liam Hennessy, The **7.** Educational Company of Ireland [ISBN: 0861674480]

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25	**75**	**100**	

ELECTRICAL CIRCUIT NETWORK SKILLS	
Learning Objective: *The aim of this course is to enable the students to design and trouble shoots the electrical circuits, networks and appliances through hands-on mode*	
UNITS	**COURSE DETAILS**
UNIT-I	**Basic Electricity Principles**: Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations. AC Electricity and DC Electricity. Familiarization with multimeter, voltmeter and ammeter. **(3 Lectures)** **Understanding Electrical Circuits**: Main electric circuit elements and their combination. Rules to analyze DC sourced electrical circuits. Current and voltage drop across the DC circuit elements. Single-phase and three-phase alternating current sources. Rules to analyze AC sourced electrical circuits. Real, imaginary and complex power components of AC source. Power factor. Saving energy and money. **(4 Lectures)**
UNIT-II	**Electrical Drawing and Symbols**: Drawing symbols. Blueprints. Reading Schematics. Ladder diagrams. Electrical Schematics. Power circuits. Control circuits. Reading of circuit schematics. Tracking the connections of elements and identify current flow and voltage drop. **(4 Lectures)** **Generators and Transformers**: DC Power sources. AC/DC generators. Inductance, capacitance, and impedance. Operation of transformers. **(3 Lectures)**
UNIT-III	**Electric Motors**: Single-phase, three-phase & DC motors. Basic design. Interfacing DC or AC sources to control heaters & motors. Speed & power of ac motor. **(4 Lectures)** **Solid-State Devices**: Resistors, inductors and capacitors. Diode and rectifiers. Components in Series or in shunt. Response of inductors and capacitors with DC or AC sources **(3 Lectures)**
UNIT-IV	**Electrical Protection**: Relays. Fuses and disconnect switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Interfacing DC or AC sources to control elements (relay protection device) **(4 Lectures)**
UNIT-V	**Electrical Wiring**: Different types of conductors and cables. Basics of

	wiring-Star and delta connection. Voltage drop and losses across cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits. Insulation. Solid and stranded cable. Conduit. Cable trays. Splices: wirenuts, crimps, terminal blocks, split bolts, and solder. Preparation of extension board. **(5 Lectures)**
TEXT BOOKS	1. A text book in Electrical Technology - B L Theraja - S Chand & Co. 2. A text book of Electrical Technology - A K Theraja **3.** Performance and design of AC machines - M G Say ELBS Edn.

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

BASIC INSTRUMENTATION SKILLS	
Learning Objective: *This course is to get exposure with various aspects of instruments and their usage through hands-on mode. Experiments listed below are to be done in continuation of the topics.*	
UNITS	**COURSE DETAILS**
UNIT-I	**Basic of Measurement:** Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. **Multimeter:** Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance. **(4 Lectures)**
UNIT-II	**Electronic Voltmeter:** Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity. Principles of voltage, measurement (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance. **AC millivoltmeter:** Type of AC millivoltmeters: Amplifier- rectifier, and rectifier- amplifier. Block diagram ac millivoltmeter**,** specifications and their significance. **(4 Lectures)**
UNIT-III	**Cathode** Ray **Oscilloscope:** Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor, visual persistence & chemical composition. Time base operation, synchronization. Front panel controls. Specifications of a CRO and their significance. **(6 Lectures)** Use of CRO for the measurement of voltage (dc and ac frequency, time period. Special features of dual trace, introduction to digital oscilloscope, probes. Digital storage Oscilloscope: Block diagram and principle of working.
UNIT-IV	**Signal Generators and Analysis Instruments:** Block diagram,

	explanation and specifications of low frequency signal generators. pulse generator, and function generator. Brief idea for testing, specifications. Distortion factor meter, wave analysis. **(4 Lectures)** **Impedance Bridges & Q-Meters:** Block diagram of bridge. working principles of basic (balancing type) RLC bridge. Specifications of RLC bridge. Block diagram & working principles of a Q- Meter. Digital LCR bridges. **(3 Lectures)**
UNIT-V	**Digital Instruments:** Principle and working of digital meters. Comparison of analog & digital instruments. Characteristics of a digital meter. Working principles of digital voltmeter. **(3 Lectures)** **Digital Multimeter:** Block diagram and working of a digital multimeter. Working principle of time interval, frequency and period measurement using universal counter/ frequency counter, time- base stability, accuracy and resolution. **(3 Lectures)**
TEXT BOOKS	1. A text book in Electrical Technology - B L Theraja - S Chand and Co. 2. Performance and design of AC machines - M G Say ELBS Edn. 3. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill. 4. Logic circuit design, Shimon P. Vingron, 2012, Springer. 5. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning. 6. Electronic Devices and circuits, S. Salivahanan & N. S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill 7. Electronic circuits: Handbook of design and applications, U.Tietze, Ch.Schenk, 2008, Springer 8. Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

WEATHER FORECASTING	
Learning Objective: *The aim of this course is not just to impart theoretical knowledge to the students but to enable them to develop an awareness and understanding regarding the causes andeffects of different weather phenomenon and basic forecasting techniques*	
UNITS	**COURSE DETAILS**
UNIT-I	**Introduction to atmosphere:** Elementary idea of atmosphere: physical structure and composition; compositional layering of the atmosphere; variation of pressure and temperature with height; air temperature; requirements to measure air temperature; temperature sensors: types; atmospheric pressure: its measurement; cyclones and anticyclones: its characteristics. **(9 Periods)**
UNIT-II	**Measuring the weather:** Wind; forces acting to produce wind; wind speed direction: units, its direction; measuring wind speed and direction; humidity, clouds and rainfall, radiation: absorption, emission

	and scattering in atmosphere; radiation laws. **(4 Periods)**
UNIT-III	**Weather systems:** Global wind systems; air masses and fronts: classifications; jet streams; local thunderstorms; tropical cyclones: classification; tornadoes; hurricanes. **(3 Periods)**
UNIT-IV	**Climate and Climate Change:** Climate: its classification; causes of climate change; global warming and its outcomes; air pollution; aerosols, ozone depletion, acid rain, environmental issues related to climate. **(6 Periods)**
UNIT-V	**Basics of weather forecasting:** Weather forecasting: analysis and its historical background; need of measuring weather; types of weather forecasting; weather forecasting methods; criteria of choosing weather station; basics of choosing site and exposure; satellites observations in weather forecasting; weather maps; uncertainty and predictability; probability forecasts. **(8 Periods)**
TEXT BOOKS	1. Aviation Meteorology, I.C. Joshi, 3rd edition 2014, Himalayan Books 2. The weather Observers Hand book, Stephen Burt, 2012, Cambridge University Press. 3. Meteorology, S.R. Ghadekar, 2001, Agromet Publishers, Nagpur. 4. Text Book of Agrometeorology, S.R. Ghadekar, 2005, Agromet Publishers, Nagpur. 5. Atmosphere and Ocean, John G. Harvey, 1995, The Artemis Press.

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

RENEWABLE ENERGY AND ENERGY HARVESTING	
Learning Objective: *The aim of this course is not just to impart theoretical knowledge to the students but toprovide them with exposure and hands-on learning wherever possible*	
UNITS	**COURSE DETAILS**
UNIT-I	**Fossil fuels and Alternate Sources of energy:** Fossil fuels and Nuclear Energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity. **(3 Lectures)**
UNIT-II	**Solar energy**: Solar energy, its importance, storage of solar energy, solar pond, non convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems. **(6 Lectures)**
	Wind Energy harvesting: Fundamentals of Wind energy, Wind

UNIT-III	Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies. **(3 Lectures)** **Ocean Energy**: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. **(3 Lectures)** Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass. **(2 Lectures)**
UNIT-IV	**Geothermal Energy**: Geothermal Resources, Geothermal Technologies. **(2 Lectures)** **Hydro Energy**: Hydropower resources, hydropower technologies, environmental impact of hydro power sources. **(2 Lectures)** **Piezoelectric Energy harvesting**: Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energy harvesting applications, Human power **(4 Lectures)**
UNIT-V	**Electromagnetic Energy Harvesting**: Linear generators, physics mathematical models, recent applications **(2 Lectures)** Carbon captured technologies, cell, batteries, power consumption **(2 Lectures)** Environmental issues and Renewable sources of energy, sustainability. **(1 Lecture)**
TEXT BOOKS	1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi 2. Solar energy - M P Agarwal - S Chand and Co. Ltd. 3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd. 4. Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004,Oxford University Press, in association with The Open University. 5. Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009 6. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA). 7. http://en.wikipedia.org/wiki/Renewable_energy

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	