THIRUVALLUVAR UNIVERSITY

DEPARTMENT OF PHYSICS

INTEGRATED M.Sc PHYSICS
(5 –YEARS)

SYLLABUS

FROM THE ACADEMIC YEAR
2023-2024

TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION,
CHENNAI - 600 005

Contents

M.Sc., PHYSICS (5 Year Integrated) SYLLABUS

Preamble

Physics is one of the basic and fundamental sciences. The curriculum for the postgraduate programme in Physics (Five years) 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 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.

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK GUIDELINES BASED REGULATIONS FOR UNDER GRADUATE PROGRAMME	
Programme:	**Integrated M.Sc. PHYSICS**
Programme Code:	
Duration:	**5 years [PG]**
Programme Outcomes:	**PO1: Disciplinary knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an integrated postgraduate 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 analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development. **PO4: Problem solving: Capacity** to extrapolate from what one has learned and applies 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, synthesizing 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, identify appropriate resources required for a project, and manage 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, formulate 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 / re-skilling.

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 researches that comply with employment laws, leading the organization towards growth and development. **PSO4**: **Contribution to Business World:** To produce employable, ethical and innovative professionals 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

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
PSO 1	Y	Y	Y	Y	Y	Y	Y	Y
PSO 2	Y	Y	Y	Y	Y	Y	Y	Y
PSO3	Y	Y	Y	Y	Y	Y	Y	Y
PSO 4	Y	Y	Y	Y	Y	Y	Y	Y
PSO 5	Y	Y	Y	Y	Y	Y	Y	Y

3 – Strong, 2- Medium, 1- Low

Highlights of the Revamped Curriculum:

- Student-centric, meeting the demands of industry and society, incorporating industrial components, hands-on training, skill enhancement modules, industrial project, project with viva-voce, exposure to entrepreneurial skills, training for competitive examinations, sustaining the quality of the core components and incorporating application oriented content wherever required.
- The Core subjects include latest developments in the education and scientific front, advanced programming packages allied with the discipline topics, practical training, devising mathematical models and algorithms for providing solutions to industry / real life

situations. The curriculum also facilitates peer learning with advanced mathematical topics in the final semester, catering to the needs of stakeholders with research aptitude.

- The General Studies and Mathematics based problem solving skills are included as mandatory components in the 'Training for Competitive Examinations' course at the final semester, a first of its kind.
- The curriculum is designed so as to strengthen the Industry-Academia interface and provide more job opportunities for the students.
- The Industrial Statistics course is newly introduced in the fourth semester, to expose the students to real life problems and train the students on designing a mathematical model to provide solutions to the industrial problems.
- The Internship during the second year vacation will help the students gain valuable work experience that connects classroom knowledge to real world experience and to narrow down and focus on the career path.
- Project with viva-voce component in the fifth semester enables the student, application of conceptual knowledge to practical situations. The state of art technologies in conducting a Explain in a scientific and systematic way and arriving at a precise solution is ensured. Such innovative provisions of the industrial training, project and internships will give students an edge over the counterparts in the job market.
- State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature are incorporated as Elective courses, covering conventional topics to the latest - Artificial Intelligence.

Value additions in the Revamped Curriculum:

Semester	Newly introduced Components	Outcome / Benefits
I	**Foundation Course:** The transition of learning from higher secondary to higher education, providing the learning Literature and analysing the world through the literary.	➢ Instill confidence among students ➢ Create interest for the subject
I, II, III, IV	**Skill Enhancement papers** (Discipline centric / Generic / Entrepreneurial)	➢ Industry ready graduates ➢ Skilled human resource ➢ Students are equipped with essential skills to make them employable
		➢ Training on language and communication skills enable the students gain knowledge and exposure in the competitive world.
		➢ Discipline centric skill will improve the Technical knowhow of solving real life problems.
III, IV, V & VI	Elective papers	➢ Strengthening the domain knowledge ➢ Introducing the stakeholders to the State - of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature ➢ Emerging topics in higher education /industry /communication network / health sector etc. are introduced with hands-on-Training.
IV	Elective Papers	➢ Exposure to industry moulds students into solution providers ➢ Generates Industry ready graduates ➢ Employment opportunities enhanced
V Semester	Elective papers	➢ Self-learning is enhanced ➢ Application of the concept to real situation is conceived resulting in tangible outcome
VI Semester	Elective papers	➢ Enriches the study beyond the course. ➢ Developing a research frame work andpresenting their independent and intellectual ideas effectively.
Extra Credits: For Advanced Learners / Honors degree		To cater to the needs of peer learners / research aspirants
Skills acquired from the Courses		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Credit Distribution for Integrated PG Programme (up to 6th Semester)

Sem I	Credit	Sem II	Credit	Sem III	Credit	Sem IV	Credit	Sem V	Credit	Sem VI	Credit
1.1. Language - Tamil	3	2.1. Language - Tamil	3	3.1. Language - Tamil	3	4.1. Language - Tamil	3	5.1 Core Course – CC IX	4	6.1 Core Course – CC XIII	4
1.2 English	3	2.2 English	3	3.2 English	3	4.2 English	3	5.2 Core Course – CC X	4	6.2 Core Course – CC XIV	4
1.3 Core Course – CC I	5	2.3 Core Course – CCIII	5	3.3 Core Course – CC V	5	4.3 Core Course – CC VII Core Industry Module	5	5. 3.Core Course CC -XI	4	6.3 Core Course – CC XV	4
1.4 Core Course – CC II	5	2.4 Core Course – CCIV	5	3.4 Core Course – CC VI	5	4.4 Core Course – CC VIII	5	5. 3.Core Course / Project with viva-voce CC -XII	4	6.4 Elective -VII Generic/ Discipline Specific	3
1.5 Elective I Generic/ Discipline Specific	3	2.5 Elective II Generic/ Discipline Specific	3	3.5 Elective III Generic/ Discipline Specific	3	4.5 Elective IV Generic/Discipline Specific	3	5.4 Elective V Generic/ Discipline Specific	3	6.5 Elective VIII Generic/ Discipline Specific	3
1.6 Skill Enhancement Course SEC-1	2	2.6 Skill Enhancement Course SEC-2	2	3.6 Skill Enhancement Course SEC-4, (Entrepreneurial Skill)	1	4.6 Skill Enhancement Course SEC-6	2	5.5 Elective VI Generic/ Discipline Specific	3	6.6 Extension Activity	1
1.7 Skill Enhancement - (Foundation Course)	2	2.7 Skill Enhancement Course –SEC-3	2	3.7 Skill Enhancement Course SEC-5	2	4.7 Skill Enhancement Course SEC-7	2	5.6 Value Education	2	6.7 Professional Competency Skill	2
				3.8 E.V.S	2			5.5 Summer Internship /Industrial Training	2		
	23		**23**		**24**		**23**		**26**		**21**
	Total Credit Points										**140**

CREDIT DISTRIBUTION FOR P.G. (up to 6th Semester)

5 – Year PG Programme - Credits Distribution (up to 6th Semester)			
		No. of Papers	**Credits**
Part I	Tamil(3 Credits)	4	12
Part II	English(3 Credits)	4	12
Part III	Core Courses (8x5 Credits & 7x 4 Credits)	15	68
	Elective Courses :Generic / Discipline Specific (3 Credits)	8	24
		Total	**116**
Part IV	Skill Enhancement Courses (6x2 credits & 1x1 credit)	7	13
	Summer Internship /Industrial Training Foundation Course	1	2
	Skill Enhancement (Foundation course)	1	2
	Professional Competency Skill Enhancement course	1	2
	EVS (2 Credits)	1	2
	Value Education (2 Credits)	1	2
		Part IV Credits	**23**
Part V	Extension Activity (NSS / NCC / Physical Education)		1
Total Credits for the Integrated PG Programme (up to 6th Semester)			**140**

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	22	18	92
Part IV	4	4	5	4	4	2	23
Part V	-	-	-	-	-	1	1
Total	23	23	24	23	26	21	140

*Part I. Part II and Part III components will be separately taken into account for CGPA calculation and classification for the integrated 5 year Post graduate programme and the other components. IV, V has to be completed during the duration of the programme as per the norms, to be eligible for obtaining the PG degree

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or Overview	
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate	
	between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

METHOD OF EVALUATION (For both Theory and Practical)

Continuous Internal Assessment	External Examination	Total
25	**75**	**100**

Credit Distribution for all UG courses with LAB Hours

First Year

Semester-I

Part	List of Courses	Credit	No. of Hours
Part-1	Language - Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Allied Courses [in Total]	13	16
Part-4	Skill Enhancement Course SEC-1 (NME)	2	2
	Foundation Course	2	2
		23	**32**

Semester-II

Part	List of Courses	Credit	No. of Hours
Part-1	Language - Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Allied Courses including laboratory [in Total]	13	16
Part-4	Skill Enhancement Course -SEC-2 (NME)	2	2
	Skill Enhancement Course -SEC-3 (Discipline/Subject Specific)	2	2
		23	**32**

Second Year

Semester-III

Part	List of Courses	Credit	No. of Hours
Part-1	Language - Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Allied Courses including laboratory [in Total]	13	15
Part-4	Skill Enhancement Course -SEC-4 (Entrepreneurial Based)	1	1
	Skill Enhancement Course -SEC-5 (Discipline / Subject Specific)	2	2
	Environmental Science (EVS)	2	2
		24	**32**

Semester-IV

Part	List of Courses	Credit	No. of Hours
Part-1	Language - Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Allied Courses including laboratory [in Total]	13	16
Part-4	Skill Enhancement Course -SEC-6 (Discipline / Subject Specific)	2	2
	Skill Enhancement Course -SEC-7 (Discipline / Subject Specific)	2	2
		23	**32**

Third Year

Semester-V

Part	List of Courses	Credit	No. of Hours
Part-3	Core Courses including Project / Elective Based	22	28
Part-4	Value Education	2	2
	Internship / Industrial Visit / Field Visit	2	-
		26	**30**

Semester-VI

Part	List of Courses	Credit	No. of Hours
Part-3	Core Courses including Project / Elective Based & LAB	18	28
Part-4	Extension Activity	1	-
	Professional Competency Skill	2	2
		21	**30**
	Total Credits	**140**	

DISCIPLINE SPECIFIC ELECTIVES

1. COMMUNICATION SYSTEMS
2. ENERGY PHYSICS
3. MATHEMATICAL PHYSICS
4. ADVANCED MATHEMATICAL PHYSICS
5. PRINCIPLES OF PROGRAMMING CONCEPTS AND C
6. MATERIALS SCIENCE
7. LASERS AND FIBER OPTICS
8. DIGITAL PHOTOGRAPHY
9. NANO SCIENCE
10. MEDICAL INSTRUMENTATION
11. AGRICULTURAL PHYSICS
12. GEO PHYSICS

DISCIPLINE SPECIFIC CORE – ELECTIVE (Compulsory)

1. DIGITAL ELECTRONICS AND MICROPROCESSOR 8085.

NON-MAJOR ELECTIVES

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

INTEGRATED M. SC DEGREE COURSE IN PHYSICS (5 YEARS) - COURSE STRUCTURE

SEMESTER I							
Title of the component and Paper		Credit	Ins. Hrs /week	Exam Hrs	Max. Marks		
Part	Study Components & Title of the Paper				CIA	U E	Total
I	Language Paper-1 – Tamil I / Other Lang.	3	6	3	25	75	100
II	Paper-1 English I	3	6	3	25	75	100
III	Core I- Properties of Matter and Acoustics	5	6	3	25	75	100
	Core II- Practical -1	5	5	3	25	75	100
	Elective I - Allied Mathematics I	3	5	3	25	75	100
IV	SEC-1 - Choose any one Course from Non Major Elective - **Physics For Everyday Life**	2	2	3	25	75	100
	Foundation Course- **Introductory Physics**	2	2	3	25	75	100
	Semester Total	23	32	-	175	525	700

SEMESTER II							
Title of the component and Paper		Credit	Ins. Hrs /week	Exam Hrs	Max. Marks		
Part	Study Components & Title of the Paper				CIA	U E	Total
I	Language Paper-2 – Tamil II / Other Lang.	3	6	3	25	75	100
II	Paper-2 English II	3	6	3	25	75	100
III	Core III - Heat, Thermodynamics and Statistical Physics	5	5	3	25	75	100
	Core IV- Practical -2	5	5	3	25	75	100
	Elective II - Allied Mathematics II	3	6	3	25	75	100
IV	SEC-2 - Choose any one Course from Non Major Elective - **Astrophysics**	2	2	3	25	75	100
	SEC-3 - Choose any one Course from Discipline Specific Elective - **Medical Instrumentation**	2	2	3	25	75	100
	Semester Total	23	32	-	175	525	700

SEMESTER III							
Title of the component and Paper		Credit	Ins. Hrs /week	Exam Hrs	Max. Marks		
Part	Study Components & Title of the Paper				CIA	U E	Total
I	Language Paper-3 – Tamil III / Other Lang	3	6	3	25	75	100
II	Paper-3 English III	3	6	3	25	75	100
III	Core V- General and Classical Mechanics	5	5	3	25	75	100
	Core VI- Practical -3	5	5	3	25	75	100
	Elective III - Allied Chemistry I	2	3	3	25	75	100
	Allied Chemistry I Practical	1	2	3	25	75	100
IV	SEC-4 – Choose any one from NME / NaanMudalvan (Entrepreneurial skill)- **Home Electrical Installation**	1	1	3	25	75	100
	SEC-5 - Choose any one Course from Discipline Specific Elective- **Nano Science**	2	2	3	25	75	100
	EVS	2	2	3	25	75	100
	Semester Total	24	32	-	225	675	900

SEMESTER IV							
Title of the component and Paper		Credit	Ins. Hrs /week	Exam Hrs	Max. Marks		
Part	Study Components & Title of the Paper				CIA	U E	Total
I	Language Paper-4 – Tamil IV / Other Lang	3	6	3	25	75	100
II	Paper-4 English IV	3	6	3	25	75	100
III	Core VII- Optics and Spectroscopy	5	5	3	25	75	100
	Core VIII- Practical -IV	5	5	3	25	75	100
	Elective IV - Allied Chemistry II	2	3	3	25	75	100
	Allied Chemistry II Practical	1	3	3	25	75	100
IV	SEC-6 - Choose any one from Naan Mudalvan / Discipline Specific Elective - **Materials Science (or) Agricultural Physics**	2	2	3	25	75	100
	SEC-7 - Choose any one Course from Discipline Specific Elective -**Lasers And Fiber Optics (or) Geo Physics**	2	2	3	25	75	100
	Semester Total	23	32	-	200	600	800

SEMESTER V							
Title of the component and Paper		Credit	Ins. Hrs /week	Exam Hrs	Max. Marks		
Part	Study Components & Title of the Paper				CIA	U E	Total
III	Core IX Atomic Physics and Lasers	4	5	3	25	75	100
	Core X Relativity and Quantum Mechanics	4	5	3	25	75	100
	Core XI Electricity, Magnetism and Electromagnetism	4	5	3	25	75	100
	Core XII- Practical V / Project with viva voce	4	5	3	25	75	100
	Elective V -- **Digital Electronics and Microprocessor 8085**	3	4	3	25	75	100
	Elective VI - Choose any one from Discipline Specific Elective - **Energy Physics (or) Mathematical Physics**	3	4	3	25	75	100
IV	Value Education	2	2	3	25	75	100
	Summer Internship / Industrial Training (Carried out in II year Summer vacation) -30 hours duration.	2	-	3	100	-	100
	Semester Total	26	30	-	275	525	800

SEMESTER VI							
Title of the component and Paper		Credit	Ins. Hrs /week	Exam Hrs	Max. Marks		
Part	Study Components & Title of the Paper				CIA	U E	Total
III	Core XIII Nuclear and Particle Physics	4	6	3	25	75	100
	Core XIV Solid State Physics	4	6	3	25	75	100
	Core XV Practical VI	4	6	3	25	75	100
	Elective VII Choose any one from Discipline Specific Elective - **Digital Photography (or) Principles Of Programming Concepts And C**	3	5	3	25	75	100
	Elective VIII - Choose any one Course from Discipline Specific Elective- **Communication Systems (or)**	3	5	3	25	75	100

	Advanced Mathematical Physics						
IV	Extension Activity	1	-	3	100	-	100
	Professional Competency Skill	2	2	3	100	-	100
Semester Total		21	30	-	325	375	700

SEMESTER I

COURSE	**FIRST SEMESTER - FOUNDATION COURSE**		
COURSE TITLE	**INTRODUCTORY PHYSICS**		
CREDITS	2	Inst. Hours	2 hours
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
TEXT BOOKS	1. D.S.Mathur, 2010, Elements of Properties of Matter,S. Chand & Co 2. BrijLal & N. Subrahmanyam, 2003, Properties of Matter,S.Chand & Co.
REFERENCE BOOKS	1. H.R. Gulati, 1977, Fundamental of General Properties of Matter, Fifth edition, S.Chand & Co.
WEBLINKS	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/

COURSEOUTCOMES:

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

COURSE OUTCOMES	**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.

MAPPING WITH PROGRAM OUTCOMES:

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	M	S	S	S	S	S	M	M	S

COURSE	**FIRST SEMESTER –CORE**		
COURSETITLE	**PROPERTIES OF MATTER AND SOUND**		
CREDITS	5	Inst. Hours	6 hours
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	**COURSEDETAILS**
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's string 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
TEXT BOOKS	1. D.S.Mathur, 2010, Elements of Properties of Matter, S. Chand & Co. 2. BrijLal & N. Subrahmanyam, 2003, Properties of Matter, S.Chand & Co 3. D.R.Khanna & R.S.Bedi, 1969, Textbook of Sound, Atma Ram & 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& 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 & Co. 3. A.P French, 1973, Vibration and Waves, MIT Introductory Physics, Arnold -Heinmann India.
WEBLINKS	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-SuaSu1s&t=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/

COURSE OUTCOMES:

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

COURSE OUTCOMES	**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**		
COURSE TITLE	**CORE PRACTICALS**		
CREDITS	5	Inst. Hours	5 hours
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		

Properties of Matter (Minimum **TEN** Experiments)

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 & 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 & 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.

COURSE	**SECOND SEMESTER - CORE**		
COURSETITLE	**Heat**, **Thermodynamics and Statistical Physics – Core 3**		
CREDITS	5	Inst. Hours	5 hours
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	COURSE DETAILS
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 **LOW TEMPERATURE PHYSICS:** 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 – un attainability of absolute zero – heat death.
UNIT-IV	**HEAT TRANSFER:** 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	**STATISTICAL MECHANICS:** 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.
TEXT BOOKS	1. Brijlal & N. Subramaniam, 2000, Heat and Thermodynamics, S. Chand &Co. 2. Narayanamoorthy & KrishnaRao, 1969, Heat, Triveni Publishers, Chennai. 3. V.R.Khanna&R.S.Bedi, 1998 1st Edition, Text book of Sound, Kedharnaath Publish & 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 & Co. 6. R.Murugeshan & Kiruthiga Sivaprasath, Thermal Physics, S.Chand & Co.
REFERENCE BOOKS	1. J.B.Rajam & C.L.Arora, 1976, Heat and Thermodynamics, 8th edition, S.Chand& Co. Ltd. 2. D.S.Mathur, Heat and Thermodynamics, Sultan Chand & Sons. 3. Gupta, Kumar, Sharma, 2013, Statistical Mechanics, 26th Edition, S. Chand & Co. 4. Resnick, Halliday&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 LINKS	1. https://youtu.be/M_5KYncYNyc 2. https://www.youtube.com/watch?v=4M72kQulGKk&vl=en

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		
COURSE TITLE	CORE PRACTICALS		
CREDITS	5	Practical Hours	5 hours
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		

HEAT, OSCILLATIONS, WAVES & SOUND (Minimum **TEN** of the given 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. Determination of frequency of an electrically maintained tuning fork
15. To verify the laws of transverse vibration using sonometer.
16. To verify the laws of transverse vibration using Melde's apparatus.
17. To compare the mass per unit length of two strings using Melde's apparatus.
18. Frequency of AC by using sonometer.

COURSE	THIRD SEMESTER - CORE		
COURSETITLE	GENERAL MECHANICS AND CLASSICAL MECHANICS		
CREDITS	5	Inst. Hours	5 hours
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 a particle in 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.
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.
TEXT BOOKS	1. J.C. Upadhyaya, 2019, Classical Mechanics, Himalaya Publishing house, Mumbai. 2. P. Durai Pandian, Laxmi Durai Pandian, Muthamizh Jaya pragasam, 2005, Mechanics, 6th revised edition, S.Chand & Co. 3. D. S. Mathur & P. S. Hemne, 2000, Mechanics, Revised Edition, S. Chand & Co. 4. Narayanamurthi, M. & Nagarathnam. 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 & 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 LINKS	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

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 - CORE**		
COURSETITLE	**CORE PRACTICALS**		
CREDITS	5	Practical Hours	5 hours
COURSE OBJECTIVES	Construct circuits to learn about the concept of electricity, current, resistance in the path of current, different parameters that affect a circuit. Set up experiments, observe, analyse and assimilate the concept		

ELECTRICITY (Minimum **TEN** of the given 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.

COURSE	**FOURTH SEMESTER - CORE**		
COURS ETITLE	**OPTICS AND SPECTROSCOPY**		
CREDITS	**5**	**Lecture Hours**	**5 hours**
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 solve problems in optics by selecting the appropriate equations and performing numerical or analytical calculations.		

UNITS	**COURSEDETAILS**
UNIT-I	**LENS AND PRISMS:** postulatesof geometrical optics – thick and thin lenses – focal length, critical thickness, power and cardinal points of a thick lens. *Lens*: lens makers formula (no derivation) – 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 – circularly and 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	**SPECTROSCOPY:** infra-red spectroscopy near infra-red and far infra-red – properties –origin of IR spectra – IR spectrophotometer – applications interpretation of IR spectra – CH, CO, CN bending and stretching vibrational modes only – scattering of light – Raman effect –classical theory –quantum theory –mutual exclusion principle – Raman spectrometer- characteristics of Raman lines –applications.
TEXT BOOKS	1. Subramaniam. N & Brijlal, 2014, Optics, 25th edition, S.Chand &Co. 2. S.L.Gupta,V.Kumar & R.C.Sharma,1997,Elements of Spectroscopy, 13th Edition, Pragati Prakashan, Meerut. 3. G.Aruldhass, 2000, Molecular Structure and Spectroscopy, II edition. PHI Pvt Ltd, New Delhi. 4. P.R.Sasikumar, 2012, Photonics, PHI Pvt Ltd, New Delhi. 5. K.Rajagopal, 2008, Engineering Physics, PHI Pvt Ltd, New Delhi. 6. V.Rajendran, 2012, Engineering Physics, Tata McGraw Hill.
REFERENCEBOOKS	1. Agarwal B.S, 2011, Optics, Kedernath Ramnath Publishers, Meerut. 2. Sathyaprakash, 1990, Optics,VII edition, Ratan Prakashan Mandhir, New Delhi. 3. C.N.Banewell, 2006, Introduction to Molecular Spectroscopy, IV edition, TMH Publishing Co, New Delhi. 4. Ajoy Ghatak, 2009, Optics, 4thedition, PHI Pvt Ltd, New Delhi. 5. Singh & Agarwal, 2002, Optics and Atomic Physics, 9thedition, Pragati Prakashan Meerut. 6. D.Halliday, R.Resnick and J. Walker, 2001, Fundamentals of Physics,6th edition, Willey, New York. 7. Jenkins A. Francis & White, 2011, Fundamentals of Optics, 4th edition, McGraw Hill Inc., NewDelhi.
WEBLINKS	1. https://science.nasa.gov/ems/ 2. https://www.youtube.com/watch?v=tL3rNc1G0qQ&list=RDCMUCzwo7UlGkb-8Pr6svxWo-LA&start_radio=1&t=2472 3. https://science.nasa.gov/ems/ 3. https://www.youtube.com/watch?v=tL3rNc1G0qQ&list=RDCMUCzwo7UlGkb-8Pr6svxWo-LA&start_radio=1&t=2472 4. https://imagine.gsfc.nasa.gov/educators/gammarraybursts/imagine/index.html 6. http://www.thephysicsmill.com/2014/03/23/sky-blue-lord-rayleigh-sir-raman-scattering/ 5. http://www.thephysicsmill.com/2014/03/23/sky-blue-lord-rayleigh-sir-raman-scattering/

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**		
COURSE TITLE	**CORE PRACTICALS**		
CREDITS	5	Practical Hours	5 hours
COURSE OBJECTIVES	Demonstrate various optical phenomena principles, working, apply with various materials and interpret the results.		

LIGHT (Minimum **TEN** of the given 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.

COURSE	**FIFTH SEMESTER - CORE**		
COURSE TITLE	**ATOMIC PHYSICS AND LASERS**		
CREDITS	**4**	**Lecture Hours**	**5 hours**
COURSE OBJECTIVES	To study about electric charges, their properties through experiments; To gain knowledge on photoelectric effect. To solve problems based on Einstein's photoelectric equation; 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 understand the principle, production and applications of lasers.		

UNITS	**COURSE DETAILS**
UNIT-I	**THE ELECTRON AND POSITIVE RAYS:** e/m of electron by Dunnington's method –charge of electron by Millikan's oil drop method – properties of positive rays –e/m of positive rays by Thomson's parabola method (*problems calculation of e/m ratio of positive rays*)–mass spectrographs and uses– Bainbridge and Dempster's mass spectrographs
UNIT-II	**PHOTOELECTRIC EFFECT:** photoelectric emission – Leonard's experiment – Richardson and Compton experiment – laws of photoelectric emission – Einstein's photoelectric equation (*problems using Einstein's photoelectric equation*) –experimental verification by Millikan's method –photoelectric cell– photo emissive cell –photovoltaic cell – photo conducting cell – applications of photoelectric cells –photomultiplier.
UNIT-III	**ATOMIC STRUCTURE:** Sommerfield's relativistic atom model –vector atom model –various quantum numbers – L-S and J-J coupling – Pauli's exclusion principle –magnetic dipole moment of an electron due to orbital and spin motion – Bohr magneton - Stern and Gerlach experiment – Lande 'g' factor.
UNIT-IV	**SPLITTING OF SPECTRAL LINES:** excitation, ionisation and critical potentials – Davis and Goucher's method – optical spectra – spectral notation and selection rules – fine structure of sodium D-line – Zeeman effect – experimental arrangement and classical theory of normal Zeeman effect – Larmor's theorem –quantum theory of normal Zeeman effect –anomalous Zeeman effect – explanation of splitting of D_1 and D_2lines of sodium – Paschen Back effect - Stark effect (Qualitative only).
UNIT-V	**LASERS: g**eneral principles of lasers – properties of lasers action – spontaneous and stimulated emission – population inversion – optical pumping – He-Ne laser (principle and working) – semiconductor laser –laser applications–holography.
TEXT BOOKS	1. R. Murugesan, Modern Physics, S. Chand & Co**. (**All units**)** (Units I & II-Problems) 2. Brijlal & N. Subrahmanyam, Atomic & Nuclear Physics, S. Chand & Co. (All units)

	3. J. B. Rajam, Modern Physics, S. Chand & Co. 4. Sehgal Chopra, Modern Physics, Sultan Chand, New Delhi 5. Avadhahnulu, An Introduction to Lasers - Theory and Applications, M.N., S.Chand & Co., New Delhi, 2001.
REFERENCE BOOKS	1. Perspective of Modern Physics, Arthur Beiser, McGraw Hill. 2. Modern Physics, S. Ramamoorthy, National Publishing & Co. 3. Laser and Non-Linear Optics by B.B.Laud, Wiley Eastern Ltd.,New York,1985.
WEBLINKS	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

COURSE OUTCOMES:

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

COURSE OUTCOMES	**CO1**	List the properties of electrons and positive rays, define specific charge of positive rays, know different mass spectrographs.
	CO2	Outline photo electric 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 X		
COURSETITLE	RELATIVITY AND QUANTUM MECHANICS		
CREDITS	4	Lecture Hours	5
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 – Eigen value – 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).

TEXT BOOKS	1. Special Theory of Relativity, S.P.Puri, Pearson Education, India, 2013 2. Concepts of Modern Physics, A.Beiser, 6th Ed., McGraw-Hill, 2003. 3. Modern Physics, R. Murugeshan, Kiruthiga Sivaprasath, S. Chand & Co., 17th Revised Edition, 2014. 4. Quantum Mechanics, S.P.Singh, M.K.Bagde, S.Chand & Co., New Delhi, 2000. 5. Quantum Mechanics in Physics and Chemistry with Applications to Biology, Rabi Majumdar, PHI, 2011. 6. Modern Physics, R. Murugesan, S.Chand & Co., New Delhi. 7. Quantum Mechanics, Gupta, Kumar and Sharma. Jai Prakash Nath & Co Meerut 8. Quantum mechanics – Satyaprakash and Swati Saluja. Kedar Nath Ram Nath & Co.
REFERENCE BOOKS	1. Fundamentals of Modern Physics, Peter J. Nolan, 1stEdition, 2014, by Physics 2. Quantum Mechanics, V.Murugan, Pearson Education, India, 2014. 3. Quantum Mechanics, Alastair I. M. Rae and Jim Napolitano, 6th Edition, CRC Press: Taylor & Francis, 2010. 4. Quantum Physics: A Fundamental Approach to Modern Physics, John S. Townsend, University Science Books, Sausalito, California, 2010. 5. Quantum Mechanics: Theory and Applications, Ajoy Ghatak and S. Lokanathan, Springer Science Business Media, Netherlands, 2004. 6. Physics of the Atom, Editor(s): M. R. Wehr, J. A. Richards, T. W. Adair, 4th Edition, Narosa, 2013. 7. Quantum Mechanics, V.Devanathan, Narosa Pub.House, Chennai,2005 8. Quantum Mechanics, V.K.Thangappan, New Age International, New Delhi. 9. A Text Book of Quantum Mechanics, Mathews &Venkatesan, Tata McGraw Hill, New Delhi. 10. Quantum Mechanics, Ghatak & Loganathan, Macmillan Publications. 11. Introduction to Quantum Mechanics, Pauling & Wilson, McGraw Hill Co., NewYork. 12. Quantum Mechanics, Gupta, Kumar and Sharma. Jai Prakash Nath &Co Meerut
WEBLINKS	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

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	**FIFTH SEMESTER – CORE XI**		
COURSETITLE	**ELECTRICITY, MAGNETISM AND ELECTROMAGNETISM**		
CREDITS	4	Lecture Hours	5 hours
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.
TEXT BOOKS	1. Murugeshan. R., - Electricity and Magnetism, 8th Edn, 2006, S.Chand and 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., Ratan and Prakash, Agra. 2. Brijlal, N.Subramanyan and Jivan Seshan, Mechanics and Electrodynamics (2005), 3. Eurasia Publishing House (Pvt.) Ltd., New Delhi. 4. David J. Griffiths, Introduction to Electrodynamics, 2nd Edn. 1997, Prentice Hall of 5. India Pvt. Ltd., New Delhi 6. D. Halliday, R. Resnik and J. Walker - Fundamentals of Physics, 6th Edn., 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

COURSE OUTCOMES:

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

COURSE OUTCOMES	**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**		
COURSETITLE	**CORE PRACTICALS**		
CREDITS	4	Practical hours	5 hours
COURSE OBJECTIVES	Demonstrate various optical phenomena principles, working, apply with various materials and interpret the results.		

Practical V - (Minimum **Twelve** of the given list)

1. Spectrometer-diffraction grating -Normal incidence-determination of dispersive power
2. Spectrometer-solid prism- determination of dispersive power
3. Specific rotation of sugar solution - polarimeter.
4. Bi-prism – Determination of refractive index.
5. Thickness of a thin film - Bi-prism
6. Brewster's law – verification- polarization
7. Diffraction at straight edge-Air wedge-determination of thickness of wire.
8. Forbe's method – Thermal conductivity of a metal rod.
9. Spectrometer– Grating - Normal incidence - Wave length of Mercury spectral lines.
10. Spectrometer – Grating - Minimum deviation - Wave length of Mercury spectral lines.
11. Spectrometer – (i-d) curve.
12. Spectrometer – (i-i′) curve.
13. Spectrometer – Narrow angled prism.
14. Spectral response of photo conductor (LDR).
15. Potentiometer –Resistance and Specific resistance of the coil.
16. Potentiometer – E.M.F of a thermocouple.
17. Deflection Magnetometer – Determination of Magnetic moment of a bar magnet and $B_H$using circular coil carrying current.
18. Vibration magnetometer - Determination of B_H using circular coil carrying current– Tan B position.
19. B.G – Figure of Merit – Charge Sensitivity
20. B.G - Comparision of coefficient of mutual inductance of coils
21. B.G - Internal resistance of a cell.

COURSE	**FIFTH SEMESTER – DISCIPLINE SPECIFIC ELECTIVE**		
COURSE TITLE	**DIGITAL ELECTRONICS AND MICROPROCESSOR 8085**		
CREDITS	3	Lecture Hours	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) –binary addition, binary subtraction using 1's & 2's complement methods – Boolean laws – De-Morgan's theorem –basic logic gates -universal logic gates (NAND & NOR) –standard representation of logic functions (SOP & POS) – minimization techniques (Karnaugh map: 2, 3, 4 variables).
UNIT-II	adders, half &full adder –subtractors, half & full subtractor –parallel binary adder – magnitude comparator – multiplexers (4:1) & 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 &ring counter – general memory operations, ROM, RAM (static and dynamic), PROM, EPROM, EEPROM, EAROM. IC – logic families: RTL, DTL, TTL logic, CMOS NAND & 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 & 16-Bit), subtraction (8-Bit & 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).
TEXT BOOKS	1. M.Morris Mano, "Digital Design" 3rd Edition, PHI, NewDelhi. 2. Ronald J. Tocci. "Digital Systems-Principles and Applications" 6/e. PHI. New Delhi. 1999.(UNITS I to IV) 3. S.Salivahana & 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 &Applications”. TMH.1994. 4. Malvino and Leach. “Digital Principles and Applications”. TMG HillEdition 5. Microprocessors and Interfacing – Douglas V.Hall 6. Microprocessor and Digital Systems – Douglas V.Hall
WEBLINKS	1. https://youtu.be/-paFaxtTCkI 2. https://youtu.be/s1DSZEaCX_g

COURSE	**SIXTH SEMESTER – CORE**		
COURSE TITLE	**NUCLEAR AND PARTICLE PHYSICS**		
CREDITS	4	Lecture Hours	6
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	**PROPERTIES OF NUCLEUS:** constituents of nucleus – isotopes, isobars, isotones – nuclear size, mass, density, charge, spin, angular momentum, magnetic dipole moment, electric quadrupole moment (qualitative) – binding energy – mass defect – packing fraction – nuclear stability – binding energy per nucleon graph – properties of nuclear force – meson theory of nuclear forces – Yukawa potential. **NUCLEAR MODELS:** liquid drop model –Weizacker's semi-empirical mass formula – shell model – magic numbers.
UNIT-II	**RADIO ACTIVITY:** radio activity – laws of radioactivity – radioactive disintegration, decay constant, half-life, mean-life (only final formulae) **–** units of radioactivity**–**successive disintegration – transient and secular equilibrium– properties of alpha, beta and gamma rays – Geiger-Nuttal law –α-ray spectra –Gammow's theory of α-decay (qualitative) –β-ray spectrum – neutrino theory of β-decay – nuclear isomerism – K-shell capture – internal conversion – non-conservation of parity in weak interactions.
UNIT-III	**PARTICLE DETECTORS AND ACCELERATORS** **DETECTORS:** gas detectors –ionization chamber – G-M counter – scintillation counter – photo multiplier tube (PMT) – semiconductor detectors – neutron detector. **ACCELERATORS:** linear accelerators – cyclotron – synchrotron – betatron– electron synchrotron – proton synchrotron (bevatron)
UNIT-IV	**NUCLEAR REACTIONS:** types of nuclear reactions –conservation laws in nuclear reaction – Q-value– threshold energy – nuclear fission – energy released in fission – chain reaction – critical mass – nuclear reactor – nuclear fusion – sources of stellar energy – proton-proton cycle – Carbon-Nitrogen cycle – thermonuclear reactions – controlled thermonuclear reactions.
UNIT-V	**COSMIC RAYS:** discovery of cosmic rays – primary and secondary cosmic rays – cascade theory of cosmic ray showers–altitude and latitude effects –discovery of positron – pair production– annihilation of matter – Van-Allen radiation belts – big-bang theory – future of the Universe (elementary ideas only). **ELEMENTARY PARTICLES:** particles and antiparticles–classification of elementary particles–types of fundamental interactions–quantum numbers of elementary particles–conservation laws and symmetry–quarks and types–quark model(elementary ideas only).

TEXT BOOKS	1. R Murugeshan & Kiruthiga Sivaprasath, Modern Physics, S. Chand & Co. (2013) 2. Brijlal& N. Subramaniyan, Atomic and Nuclear Physics S Chand &Co 3. J.B. Rajam, Modern Physics, S Chand &Co. Publishing Co. 4. D.C. Tayal, Nuclear Physics, Himalayan Publishing House 5. Atomic and Nuclear Physics, Brijlal & N.Subramaniyan, S.Chand & Co
REFERENCE BOOKS	1. Basic ideas and concepts in Nuclear Physics, K.Heyde, 3rd Edn., Institute of Physics Pub. 2. Introductory nuclear Physics by Kenneth S.Krane (Wiley India P. Ltd, 2008) 3. Concepts of nuclear physics by Bernard L. Cohen. (Tata Mc Graw Hill, 1998). 4. Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004). 5. Introduction to High Energy Physics, D.H. Perkins, Cambridge Univ. Press 6. Introduction to Elementary Particles, D. Griffith, John Wiley & Son 7. Quarks and Leptons, F.Halzen and A.D.Martin, Wiley India, New Delhi 8. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000). 9. Theoretical Nuclear Physics, J.M. Blatt & V.F.Weisskopf (Dover Pub. Inc., 1991) 10. Physics and Engineering of Radiation Detection, Syed Naeem Ahmed (Academic Press, Elsevier, 2007). 11. Nuclear Physics, S. N. Ghoshal, S Chand & Co. Edition 2003 12. Elements of Nuclear Physics, M. L.Pandya & R. P. S.Yadav, KedarNath & Ram Nath
WEBLINKS	1. http://hyperphysics.phy-astr.gsu.edu/hbase/nuccon.html 2. https://www.kent.edu/physics/nuclear-physics-links 3. https://www2.lbl.gov/abc/links.html

COURSE OUTCOMES:

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

COURSE OUTCOMES	**CO1**	Describe various models that explain about the nuclear structures
	CO2	Give reason for various kinds of radioactivity and also know laws governing them
	CO3	Know the principles and applications of various particle detectors and accelerators.
	CO4	Discuss the concepts used in nuclear reaction.
	CO5	Classify various elementary particles and study the effect of cosmic rays.

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	S	S	M	S	M	M	S	M	M	M
CO3	M	M	S	M	S	M	M	S	S	S
CO4	S	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	Lecture Hours	6
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 mono atomic and diatomic chains. acoustical and optical phonons –qualitative description of the phonon spectrum in solids – Dulong and Petit's Law – Einstein and Debye theories of specific 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 – Weide mann-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 of dia, para, ferro, ferri and anti-ferromagnetism –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 & 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)
TEXT BOOKS	1. Introduction to Solid State Physics,Kittel, Willey Eastern Ltd (2003). 2. Solid state Physics, Rita John,1st edition, TataMcGraw Hill publishers (2014). 3. Solid State Physics , R L Singhal, Kedarnath Ram Nath& 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&Babber – Solid State Physics – S.Chand&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
WEBLINKS	1. https://nptel.ac.in/courses/115105099/ 2. https://nptel.ac.in/courses/115106061/

COURSE OUTCOMES:

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

COURSEOUTCOMES	**CO1**	Classify the bonding &crystal structure also learns 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	**CORE PRACTICALS**		
CREDITS	4	Practical Hours	6 hours
COURSE OBJECTIVES	To perform basic experiments on characteristics of electronic devices and then get into the applications such as amplifiers, oscillators, counters and multivibrators. To Perform fundamental experiments on microprocessor 8085 and learn to write programs by themselves.		

Electronics (Minimum **FIFTEEN** of the given list)

1. RC coupled CE transistor amplifier - single stage.
2. Transistor Emitter follower.
3. Colpitt's oscillator -transistor.
4. Hartley oscillator - transistor.
5. Astable multivibrator - transistor.
6. Bistable multivibrator - transistor.
7. FET (BFW10)- characteristics.
8. UJT (2N2646) -characteristics
9. AC circuits with L C R -Series resonance.
10. AC circuits with L C R - Parallel resonance.
11. Op- amp - inverting amplifier and summing, difference & average
12. Op- amp - non-inverting amplifier and summing, difference & average
13. Op- amp - differentiator & integrator.
14. Op- amp - D/A converter by binary weighted resistor method.
15. 5V, IC 7805 Regulated power supply.
16. Study of gate ICs – NOT, OR, AND, NOR, NAND, XOR & XNOR
17. Verification of De Morgan's theorem using ICs –NOT, OR, AND
18. NAND / NOR as universal building block.
19. Half adder / Half subtractor using basic logic gate ICs
20. Microprocessor 8085 – addition, subtraction (8 bit only)
21. Microprocessor 8085 – multiplication, division (8 bit only)
22. Microprocessor 8085 – square (8 bit only)
23. Microprocessor 8085 – square root (8 bit only)
24. Microprocessor 8085 – largest/smallest of numbers (8 bit only)
25. Microprocessor 8085 –ascending/descending order

DISCIPLINE SPECIFIC CORE ELECTIVES

STUDENTS CAN CHOOSE ANY OF THESE SUBJECTS IN SEM V AND VI

1. COMMUNICATION PHYSICS			
Credits	**3**	**Ins Hours**	**5**
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 & Co Ltd., 2013 2. Anokh Singh and Chopra A.K., Principles of communication Engineering, S. Chand & 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.		

2. ENERGY PHYSICS			
Credits	**3**	**Ins Hours**	**4**
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 & 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, Rakesh Rajan, PHI Learning Pvt Ltd, 2011, 2nd Edn.		
REFERENCE BOOKS	1. John Twidell & Tony Weir, Renewable Energy Resources, Taylor& Francis, 2005, 2nd Edn. 2. S.A. Abbasi and NasemaAbbasi, Renewable Energy sources and their environmental impact, PHI Learning Pvt. Ltd, 2008. 3. M. P. Agarwal, Solar Energy, S. Chand & Co. Ltd., New Delhi,1982 4. H. C. Jain, Non-Conventional Sources of Energy, Sterling Publishers, 1986.		

3. MATHEMATICAL PHYSICS			
Credits	**3**	**Ins Hours**	**4**
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 & 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 of single pulse – trigonometric, exponential and Gaussian functions – 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 & 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. Kusse & Erik A. Westwig, 2nd Ed, WILEY-VCH Verlag, 2006. 4. Vector space & Matrices – J. C. Jain, Narosa Publishing House Pvt. Ltd.		

4.ADVANCED MATHEMATICAL PHYSICS			
Credits	**3**	**Ins Hours**	**4**
Learning Objectives: 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 & 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, 4th Edition (2006) 2. Mathematical Physics, SatyaPrakash (Sultan Chand)		
REFERENCE BOOKS	1. Mathematical Methods or 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 (Sri Krishna Prakashan)		

5. PRINCIPLES OF PROGRAMMING CONCEPTS AND C PROGRAMMING			
Credits	**3**	**Ins Hours**	**5**

Learning Objective: The main objectives of this course are to:

1. Develop logics which will aid in developing programs and applications
2. Solve problems using functional and object – oriented paradigm
3. Use ideas from various paradigms when programming in a language of different paradigm.

UNITS	COURSE DETAILS
UNIT-I	**Constants, Variables and Data types** : Introduction – character sets – constants – keywords – identifiers – variables – data types – Declaration of variables – assigning values to variables –defining symbolic constants
UNIT-II	**Operators and Expressions:** Arithmetic operators – relational operators – logical operators – assignment operators – increment and decrement operators – conditional operators – special operators – arithmetic expression – evaluation of expressions –Precedence of arithmetic operators –type conversion in expression – Operator precedence and associativity – mathematical functions.
UNIT-III	**Input and Output Operations:** Reading and writing character – formatted input and output – decision making: IF statement: Simple IF, IF... ELSE, Nesting of IF…ELSE and ELSE IF Ladder – Switch Statement –? : operator – go to statement – while, do – while statement – For loop
UNIT-IV	**Arrays:** Introduction – One dimensional array – declaration of array – Initiating on two and multi dimensional arrays – declaring and initializing string variables – reading strings from terminal–writing strings on the screen.
UNIT-V	**User Defined Functions:** Need for user defined functions – A multifunction program – The form of C Functions – RETURN values and their Types – Calling a function – Call by Value –Call by Reference - Recursive functions
TEXT BOOKS	1. Programming in ANSI C, E. Balagurusamy, TMH (2008) 2. The C Programming Language, Brian Kernighan, Dennis Ritchie, Prentice Hall (1978)
REFERENCE BOOKS	1. Programming in C by Ashok N. Kamthane First Indian Print, Pearson (2004). 2. Computing Fundamentals and C Programming, E. Balagurusamy, TMH (2011)
Web links	1. https://www.programiz.com/c-programming 2. https://www.geeksforgeeks.org/c-language-set-1-introduction/ 3. https://beginnersbook.com/2014/01/c-tutorial-for-beginners-with-examples/

6. MATERIALS SCIENCE			
Credits	**2**	**Ins Hours**	**2**
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 &twist 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 – visco elastic behavior of materials – spring-Dash pot models of visco elastic 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 publications2011		
REFERENCE BOOKS	1. William D. Callister, Jr., Material Science & Engineering – An Introduction, 8th Edition, John Wiley & Sons, Inc., 2007 2. W. Bolton, "Engineering materials technology", 3rd Edition, Butter worth & Heinemann, 2001. 3. Donald R. Askeland, Pradeep P. Phule, "The Science and Engineering of Materials", 5th Edition, Thomson Learning, First Indian Reprint, 2007. 4. William F. Smith, "Structure and Properties of Engineering Alloys", Mc-Graw-Hill Inc., U.S.A, 2nd edition, 1993.		

7. LASERS AND FIBER OPTICS			
Credits	**2**	**Ins Hours**	**2**
Learning Objective: The students will learn the fundamentals, types of lasers, laser instrumentation and their applications also to 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 Q switching–Theory of mode locking– cavity dumping.		
UNIT-II	**TYPES OF LASER: s**olid state laser: ruby laser, Nd: YAG laser, Nd: Glass laser– semiconductor laser: intrinsic semiconductor laser, doped semiconductorlaser, injection laser – dye laser – chemical laser: HCL laser, DF- CO_2, CO chemical laser. Gas laser: neutral atom gas laser (He-Ne laser), CO_2laser, Copper vapour laser.		
UNIT-III	**APPLICATIONS OF LASER:** application of laser in metrology – optical communication – material processing: laser instrumentation of material processing, powder feeder, laser heating, laser welding, laser melting – medical application – Laser instrumentation for surgeries – laser in astronomy		
UNIT-IV	**FIBER OPTICS:** basic components of optical fiber communication – principles of light propagation through fiber – total internal reflection – optical fiber – coherent bundle – numerical aperture and skew mode – phase shift and attenuation during total internal reflection – types of fiber: single mode and multi-mode fiber – step index and graded index fiber – fiber optic sensors – application of fiber optics.		
UNIT-V	**CHARACTERISTICS AND FABRICATION OF OPTICAL FIBER:** 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 & Co,NewDelhi 3. J.Wilson and J.F.B. Hawkes. 'Introduction to Opto Electronics', Pearson Education, 2018.		
REFERENCE BOOKS	1. A.Sennaroglu,"Photonics and Laser Engineering: Principles, Devices and Applications McGraw-HillEducation,2010. 2. K.R.Nambiar, "Lasers: Principles, Types and Applications", New Age International, 2004. 3. Optic, Ajoy Ghatak, McGraw-Hill Education (India)Pvt,Ltd, 6thEdn., 2017.		

8. DIGITAL PHOTOGRAPHY			
Credits	**3**	**Ins Hours**	**5**
Learning Objective: To understand the principles of photography and image formation and the science and arts behind it. To understand the essential components ofconventional 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 & JPEG) – storage cards and types – digital cameras: camera phones – compact camera – hybrid camera – digital SLR.		
UNIT-V	**THE DIGITAL IMAGE – POST PRODUCTION:** hardware: computer and its peripherals – software: saving digital file – basic editing: navigating the image – undo/redo/history – crop – rotate – brightness &contrast – colour balance – hue/saturation – dodge/burn – cloning &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 & 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		

9. NANOSCIENCE			
Credits	**2**	**Ins Hours**	**2**
Learning Objective: This course aims to provide an overall understanding of Nano science and Nanotechnology and introduces different types of nano materials, their properties, fabrication methods, characterization techniques and a range of applications.			
UNITS	**COURSE DETAILS**		
UNIT-I	**NANOSCIENCE AND NANOTECHNOLOGY:** nano scale– nature and nanostructures – nanostructures: 0D, 1D,2D– surface to volume ratio– size effect – excitons – quantum confinement– metal based nano particles (metal and metal oxide) – nano composites (non-polymer based) – carbon nanostructures – fullerene –SWCNT and MWCNT		
UNIT-II	**PROPERTIES OF NANO MATERIALS:** introduction –mechanical behavior –elastic properties – hardness and strength – ductility and toughness –super plastic behavior – optical properties – surface plasmon resonance – electrical properties – dielectric materials and properties – magnetic properties – super paramagnetism – Electro chemical properties – properties of CNTs.		
UNIT-III	**FABRICATION METHODS AND VACUUM TECHNIQUES:** top-down and bottom-up approaches – electrochemical method – chemical & physical vapour depositions (CVD & 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 – super capacitors– photovoltaics. Sensors: nano sensors based on optical and physical properties – electrochemical sensors – nano bio sensors. Nano electronics: CNTFET – display screens – GMR read/write heads – nano robots –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 & Sons 3. B.S. Murty, et al(2012)Textbook of Nanoscience and Nano technology, Universities Press.		

10 MEDICAL INSTRUMENTATION			
Credits	**2**	**Ins Hours**	**2**
Learning Objective: This course aims to provide background of the Physics principles in medical instrumentation technologies through theoretical & 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 – radio pharmaceuticals – technetium generator – gamma camera – positron emission tomography – disposal of radioactive waste.		
UNIT-IV	**ULTRASOUND IMAGING:** ultrasound transducer – ultrasound imaging– Doppler ultrasound – ultrasound image quality & bio-effects. **MAGNETIC RESONANCE IMAGING:** proton & 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 & 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) Bio-instrumentation 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		

11.AGRICULTURAL PHYSICS			
Credits	**2**	**Ins Hours**	**2**

Learning Objective: The main objectives of this course are to:

1. Have knowledge of physical phenomena in agricultural environment.
2. Evoke logical thinking in the field of farming.
3. Improve practical knowledge of the student.

UNITS	COURSE DETAILS
UNIT-I	**Soil Physics**: Mechanical composition of soil– physical properties of soil, pore space, bulk density, particle density – classification – significance of clays – plasticity, shrinkage, flocculation and de-flocculation –Soil structure –soil colour – Thermal properties of soil and soil temperatures –types of soil water – its retention, movement – viscosity, swelling – soil moisture losses – Elementary ideas of soil water conservation.
UNIT-II	**Water Physics** : Water qualities–Rainfall–Groundwater–surface water pollution – instrumentation and sampling -Water quality monitoring
UNIT-III	**Electric Power**: Principle of production of A.C. – Average value of A.C. voltage or current – R.M.S. value of alternating voltage or current –power consumed in A.C. Circuits–kilo watt hour–A.C. generator –Three-phase A.C.–Distribution of three phase A.C. Three – phase power system–The choke - The transformer–Transmission of electric power over long distances.
UNIT-IV	**Hygrometry and Pumps:** Absolute Humidity – Relative Humidity– Dew point, Daniell's Hygrometer, Regnault's hygrometer. Advantages of Regnault's hygrometer – wet and Dry and Bulb hygrometer. Water pumps – common pump – force pump – Fire engine, inflator (or) compression pump – pressure after n strokes – Exhaust pump (or) common air pump.
UNIT-V	**Solar Collector and Applications:** Solar Air heaters Application of solar air heaters. Solar Drying with various driers –Heating and Drying of Agricultural products –Theory of solar drying moisture content and its measurement –Solar ponds – Application of solar ponds – Solar pumping –Solar pump system components – Turbine driven pump – Application of solar energy to agricultural crops
TEXT BOOKS	1. The Nature and Properties of Soil, H.O.Buckman, Brady, Macmillan, (1967) 2. Soil Physics, H.Kohnke, McGraw-Hill,(1968). 3. Systematic Hydrology, John C.Rodda, Richard A.Downing, Frank M.Law, Newnes - Butterworths,(1976).
REFERENCE BOOKS	1. Electricity and Magnetism, R.Murugesan, S.Chand,(2017). 2. Hydrostatics, A.S.Ramsey, CambridgeUniversityPress,(2017). 3. SolarenergyUtilization, G.D.Rai, Khanna Publisers,(1987).
Web links	1. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/soil-physics 2. https://www.sciencedirect.com/science/article/pii/S1631071304002780 3. https://www.sciencedirect.com/topics/engineering/solar-energy-application

12.GEO PHYSICS			
Credits	**2**	**Ins Hours**	**2**

Learning Objective: The main objectives of this course are to:

1. Study the physical properties of earth and how it works.
2. Study various features of earth using gravity, magnetic, electrical and seismic methods.
3. Understand all physical parameters of the geo thermal field.

UNITS	**COURSE DETAILS**
UNIT-I	**Seismology:** Introduction – Seismology – P waves, S waves, their velocities – Time distance curves and the Location of epicenters – Effect of boundaries – Major discontinuities and resulting phase of seismic waves - Derivation of properties from the velocities.
UNIT-II	**Surfacewaves**: Rayleigh waves and Love waves –Study of earth by surface waves. **Seismometry**: Horizontal seismograph and seismography equation– Strain seismograph.
UNIT-III	**Earthquakes**: Focus, magnitude, frequency – Detection and prediction. **Gravity**: The potential (Laplace's equation and Poisson's equation)- Absolute and relative measurements of gravity - Hammond Faller method - Worden gravimeter
UNIT-IV	**Geomagnetism**: Fundamental equations - Measurements: method of Gauss, saturation induction magnetometers, proton precession magnetometers, alkali vapour magnetometers - Theories of earth's magnetism – Causes of the main field - Dynamo theories. **Internal structure of the earth**: The core variation of mechanical properties with depth - Materials and equation of state of the interior of the earth.
UNIT-V	**Geochronology**: Radioactivity of the earth – Radioactive dating of rock sand minerals Geological time scale – The age of the earth. **Geo thermal physics**: Flow of heat to the surface of the earth - Sources of heat within the earth - Process of heat transport –Internal temperature of the earth.
TEXT BOOKS	1. Introduction to Geophysics Mantle Core And Crust, G.D. Garland, Philadelphia, W.B.Saunders, (1971). 2. Physics of the Earth and Planets, A.H.Cook, McMillan,(1973).
REFERENCE BOOKS	1. Fundamentals of Geophysics, William Lowrie, Andreas Fichtner, Cambridge University Press, (1997). 2. Exploration Geophysics, Mamdouh R. Gadallah, RayFisher, Springer Science & Business Media,(2008).
Web links	1. https://nptel.ac.in/content/storage2/courses/105101083/download/lec5.pdf 2. https://www.youtube.com/playlist?list=PLfk0Dfh13pBPXtgn8BT-dpkfaWMRusJwI

NON MAJOR ELECTIVES (NME)

PHYSICS FOR EVERYDAY LIFE			
Credits	**2**	**Ins Hours**	**2**
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, Umme Ammara, Gugucool Publishing, Hyderabad, 2019. 2. For the love of physics, Walter Lawin, Free Press, New York, 2011.		

ASTROPHYSICS			
Credits	**2**	**Ins Hours**	**2**
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 & 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. Baidyanath Basu, (2001). An introduction to Astrophysics, Secondprinting, 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. & Madhusudan, H.R.,(1999), Eclipse: A CelestialShadow Play, Orient Black Swan,

MEDICAL PHYSICS			
Credits	**2**	**Ins Hours**	**2**
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 bio molecules – 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

HOME ELECTRICAL INSTALLATION			
Credits	**1**	**Ins Hours**	**2**
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 & 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).

PHYSICS OF MUSIC			
Credits	**2**	**Ins Hours**	**2**
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 & solids – velocity, frequency, wavelength, time period, intensity: definition and unit fs – classification of sound on frequency and velocity– human & 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 & phases– partial tones – assembly of pure tones– mix of different frequencies & 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 & bowed, guitar, mandolin, violin, piano, etc. – *wind instruments*: whistles, flute, saxophone, pipe organ, bag pipes, 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 & SOUND:** Edison phonograph – cylinder & 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 & far fields of acoustic– spectral analysis techniques – continuous & 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)		

COURSE	**ALLIED PAPER**		
COURSETITLE	**ALLIED PHYSICS – I**		
CREDITS	3	Lecture hours	3 hours
COURSE OBJECTIVES	To impart basic principles of 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, ultra sonography – ultra sonoimaging- 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 Meit Y, NIELIT- semiconductor laboratories under Dept. of Space – an introduction to Digital India

TEXT BOOKS	1. R. Murugesan (2001), Allied Physics, S. Chand & 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 & Co., NewDelhi. 4. J.B. Rajam and C.L.Arora (1976). Heat and Thermodynamics (8^{th} edition), S. Chand & Co., New Delhi. 5. R. Murugesan (2005), Optics and Spectroscopy, S. Chand & 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}e dition), John Willey and Sons, Asia Pvt.Ltd., Singapore. 2. V.R. Khanna and R.S.Bedi (1998), Text book of Sound 1^{st} Edn. Kedhar naath Publish & Co, Meerut. 3. N.S.Khare and S.S. Srivastava (1983),Electricity and Magnetism 10^{th} Edn., Atma Ram & Sons, New Delhi. 4. D.R.Khanna and H.R. Gulati (1979). Optics, S.chand& Co.Ltd., New Delhi. 5. V.K. Metha (2004). Principles of electronics 6^{th} Edn. S. Chand and company.
WEBLINKS	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=9mXOMzUruMQ&t=1shttps://www.youtube.com/watch?v=m4u-SuaSu1s&t=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:

COURSE OUTCOMES	**CO1**	Explain types of motion andextend their knowledge in the study of variousdynamicmotionsanalyzeand demonstrate mathematically. Relate theory with practical applications in medical field.
	CO2	Explaintheirknowledgeofunderstandingaboutmaterialsandtheir behaviorsandapplyittovarioussituationsinlaboratoryandreal 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 back ground of growth of this technology.
	CO4	Articulate the knowledge about electric current resistance, capacitance in terms of potential electric field andelectric 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, NOTbasic logic gates and intend their ideas to universal building blocks. Infer operations using Boolean algebra and acquire elementary ideas of IC circuits. Acquire information about variousGovt. programs/ institutions in this field.

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	**ODD SEMESTER - CORE**		
COURSETITLE	**ALLIED PRACTICALS – I**		
CREDITS	3	Practical hours	3 hours
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 8 Experiments			
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 5. Surface tension and interfacial Surface tension – drop weight method 6. Comparison of viscosities of two liquids – burette method 7. Specific heat capacity of a liquid – half time correction			

8. Verification of laws of transverse vibrations using sonometer
9. Calibration of low range voltmeter using potentiometer
10. Determination of thermo emf using potentiometer
11. Verification of truth tables of basic logic gates using ICs
12. Verification of De Morgan's theorems using logic gate ICs.
13. Use of NAND as universal building block.

Note : Use of digital balance permitted

COURSE	**ALLIED PAPER**		
COURSETITLE	**ALLIED PHYSICS –II**		
CREDITS	3	Lecture Hours	3 hours
COURSE OBJECTIVES	To understand the basic concepts of optics, modern Physics, concepts of relativity and quantum physics, semi-conductor 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
TEXT BOOKS	1. R. Murugesan (2005), Allied Physics, S. Chand & Co, NewDelhi. 2. K.Thangaraj and D.Jayaraman (2004), Allied Physics, Popular Book Depot, Chennai. 3. Brijlal and N.Subramanyam (2002), Text book of Optics, S. Chand & Co, NewDelhi. 4. R.Murugesan (2005), Modern Physics, S. Chand & Co, NewDelhi. 5. A. Subramaniyam Applied Electronics, 2nd Edn., National Publishing Co.,Chennai.
REFERENCE BOOKS	1. Resnick Halliday and Walker (2018), Fundamentals of Physics, 11th Edn., John Willey and Sons, Asia Pvt. Ltd., Singapore. 2. D.R.Khanna and H.R.Gulati (1979). Optics, S. Chand & Co. Ltd., New Delhi. 3. A. Beiser (1997), concepts of Modern Physics, Tata Mc Graw 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.
WEBLINKS	1. https://www.berkshire.com/learning-center/delta-p-facemask/https://www.youtube.com/watch?v=QrhxU47gtj4https://www.youtube.com/watch?time_continue=318&v=D38BjgUdL5U&feature=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

COURSE OUTCOMES:

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

COURSEOUTCOMES	**CO1**	Explain the concepts of interference diffraction using principles of super position 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 of interpreting improving theoretical models based on observation. Appreciate interdisciplinary nature of science and in solar energy related applications.

	CO3	Summarize the properties of nuclei, nuclear force structure of atomic nucleus and nuclear models.Solve problems on delay rate half-life and mean-life. Interpretnuclear processes like fission and fusion. Understand theimportance of nuclear energy, safety measures carried and get our Govt. agencies like DAE guiding the country in the nuclearfield.
	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 PRACTICALS – II**
CREDITS	3
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 **TEN** Experiments

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

***Note* : Use of digital balance permitted**