THIRUVALLUVAR UNIVERSITY

SERKKADU, VELLORE–632115

B.Sc. PHYSICS

SYLLABUS

FROM THE ACADEMIC YEAR

2023 – 2024

Contents

B.Sc. PHYSICS SYLLABUS

Preamble

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

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

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

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK GUIDELINES BASED REGULATIONS FOR UNDER GRADUATE PROGRAMME	
Programme:	**B.Sc. PHYSICS**
Programme Code:	U28
Duration:	**3 years [UG]**
Programme Outcomes:	**PO1: Disciplinary knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study **PO2: Communication Skills:** Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups. **PO3: Critical thinking:** Capability to apply 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 apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations. **PO5: Analytical reasoning**: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints. **PO6: Research-related skills**: A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesising and articulating; Ability to recognise cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation **PO7: Cooperation/Team work:** Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team **PO8: Scientific reasoning**: Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective. **PO9: Reflective thinking**: Critical sensibility to lived experiences, with self awareness and reflexivity of both self and society. **PO10 Information/digital literacy:** Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of

	data. **PO 11 Self-directed learning**: Ability to work independently, 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 toembrace 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 demonstratingthe ability to identify ethical issues related to one‟s work, avoid unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work. **PO 14: Leadership readiness/qualities:** Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way. **PO 15: Lifelong learning:** Ability to acquire knowledge and skills, including „learning how to learn‟, that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.

Programme Specific Outcomes: **(These are mere guidelines. Faculty can create POs based on their curriculum or adopt from UGC or University for their Programme)**	**PSO1: Placement:** To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, and beliefs and apply diverse frames of reference to decisions and actions. **PSO 2**: **Entrepreneur:** To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate start-ups and high potential organizations **PSO3**: **Research and Development:** Design and implement HR systems and practices grounded in research that 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 & 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** To ease the transition of learning from higher secondary to higher education, providing an overview of the pedagogy of learning Literature and analysing the world through the literary lens gives rise to a new perspective.	➢ 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 framework and presenting 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 UG Programme

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 –Theory	4	6.1 Core Course – CC XIII–Theory	4
1.2 English	3	2.2 English	3	3.2 English	3	4.2 English	3	5.2 Core Course – CC X–Theory	4	6.2 Core Course – CC XIV–Theory	4
1.3 Core Course – CC I (Theory)	5	2.3 Core Course – CC III (Theory)	5	3.3 Core Course – CC V (Theory)	5	4.3 Core Course – CC VII –Theory/ Core Industry Module	5	5. 3.Core Course CC -XI–Theory	4	6.3 Core Course – CC XV–Practicals	4
1.4 Core Course – CC II (Practical)	5	2.4 Core Course – CC IV (Practicals)	5	3.4 Core Course – CC VI (Practicals)	5	4.4 Core Course – CC VIII (Practicals)	5	5. 3.Core Course – Practicals / Project with viva- voce CC -XII	4	6.4 Elective -VII Generic/ Discipline Specific	3
1.5 Elective I Generic/ Discipline Specific (Allied Course I)	3	2.5 Elective II Generic/ Discipline Specific (Allied Course II)	3	3.5 Elective III Generic/ Discipline Specific (Allied Course III-Theory and Practical)	2+1	4.5 Elective IV Generic/ Discipline Specific (Allied Course IV-Theory and Practical)	2+1	5.4 Elective V Generic/ Discipline Specific	3	6.5 Elective VIII Generic/ Discipline Specific	3
1.6 Skill Enhancement Course SEC-1 (NME)	2	2.6 Skill Enhancement Course SEC-2 (NME)	2	3.6 Skill Enhancement Course SEC-4, (Entrepreneurial Skill)-(Naan Mudhalvan/NME)	1	4.6 Skill Enhancement Course SEC-6 – (Naan Mudhalvan/Discipline Specific)	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(Discipline Specific)	2	3.7 Skill Enhancement Course SEC-5- (Discipline Specific)	2	4.7 Skill Enhancement Course SEC-7- (Discipline Specific)	2	5.6 Value Education	2	6.7 Professional Competency Skill	2
				3.8 E.V.S	-	4.8 E.V.S	2	5.5 Summer Internship /Industrial Training	2		
	23		**23**		**22**		**25**		**26**		**21**
	Total Credit Points										**140**

CREDIT DISTRIBUTION FOR U.G.

3 – Year UG Programme Credits Distribution			
		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
	Part III Credits		92
	Skill Enhancement Courses (6x2 credits & 1x1 credit)	7	13
	Summer Internship /Industrial Training	1	2
	Foundation Course	1	2
	Extension Activity (NSS / NCC / Physical Education)	1	1
	EVS (2 Credits)	1	2
	Value Education (2 Credits)	1	2
Part IV Credits			**22**
Part V	Professional Competency Skill	1	2
Total Credits for the UG Programme			**140**

Consolidated Semester wise and Component wise Credit distribution

Parts	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total
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	3	6	4	1	22
Part V	-	-	-	-	-	2	2
Total	23	23	22	25	26	21	**140**

***Part I. II, and Part III components will be separately taken into account for CGPA calculation and classification for the under graduate programme and the other components. IV, V have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the UG 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	

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	3	6	4	1	22
Part V	-	-	-	-	-	2	2
Total	23	23	22	25	26	21	**140**

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

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	14
Part-4	Skill Enhancement Course SEC-1 (NME)	2	2
	Foundation Course	2	2
		23	**30**

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	14
Part-4	Skill Enhancement Course -SEC-2 (NME)	2	2
	Skill Enhancement Course -SEC-3 (Discipline/Subject Specific)	2	2
		23	**30**

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	14
Part-4	Skill Enhancement Course -SEC-4 (Entrepreneurial Based)	1	1
	Skill Enhancement Course -SEC-5 (Discipline / Subject Specific)	2	2
	E.V.S	-	1
		22	**30**

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	13
Part-4	Skill Enhancement Course -SEC-6 (Discipline / Subject Specific)	2	2
	Skill Enhancement Course -SEC-7 (Discipline / Subject Specific)	2	2
	E.V.S	2	1
		25	**30**

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	0
		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**	

Remarks: English Soft Skill Two Hours will be handled by English Teachers (4+2 = 6 hours for English).

NON-MAJOR ELECTIVES

1. PHYSICS FOR EVERYDAY LIFE (Semester-I)
2. ASTROPHYSICS (Semester-II)
3. PHYSICS OF MEDICAL INSTRUMENTS (Semester-II)
4. ENERGY PHYSICS (Semester-III)
5. NANOSCIENCE AND NANOTECHNOLOGY (Semester-III)

DISCIPLINE SPECIFIC CORE ELECTIVE (COMPULSORY) - (Semester-VI)

1. DIGITAL ELECTRONICS AND MICROPROCESSOR 8085

DISCIPLINE SPECIFIC CORE ELECTIVES (OPTIONAL)

1. COMMUNICATION SYSTEMS (Semester-II)
2. BASIC AND APPLIED ELECTRONICS (Semester-III)
3. MATHEMATICAL PHYSICS (Semester-IV)
4. ADVANCED MATHEMATICAL PHYSICS (Semester-IV)
5. NUMERICAL METHODS AND C PROGRAMMING (Semester-IV)
6. MATERIALS SCIENCE (Semester-V)
7. LASERS AND FIBER OPTICS (Semester-V)
8. DIGITAL PHOTOGRAPHY (Semester-VI)
9. MEDICAL INSTRUMENTATION (Semester-VI)

The Course of Study and the Scheme of Examinations

S. No.	Part	Study Components Course Title		Ins. Hrs / week	Credit	Title of the Paper	Maximum Marks		
SEMESTER III							**CIA**	**Uni. Exam**	**Total**
15.	I	Language	Paper-3	6	3	Tamil/Other Languages	25	75	100
16.	II	English	Paper-3	6	3	English	25	75	100
17.	III	Core Course –CC V (Theory)	Paper-3	5	5	General and Classical Mechanics	25	75	100
18.	III	Core Course –CC VI (Practical)	Practical-3	5	5	Core Practical	25	75	100
19.	III	Elective III Generic/ Discipline Specific	Elective III	5	3	Chemistry I	25 25	75 75	100 100
20.	IV	Skill Enhancement Course SEC-4, (Entrepreneurial Skill)-	Paper-3	1	1	BASIC AND APPLIED ELECTRONICS	25	75	100
21.	IV	Skill Enhancement Course SEC-5- (Discipline Specific)	Paper-2	2	2	Choose any one Course from A. ENERGY PHYSICS B. NANOSCIENCE AND NANOTECHNOLOGY	25	75	100
22	IV	E.V.S	-	2	2	Environmental Studies	0	0	0
		Sem. Total		**32**	**24**		**200**	**600**	**800**
SEMESTER IV							**CIA**	**Uni. Exam**	**Total**
23.	I	Language	Paper-4	6	3	Tamil/Other Languages	25	75	100
24.	II	English	Paper-4	6	3	English	25	75	100
25.	III	Core Course – CC VII –Theory/ Core Industry Module	Paper-4	5	5	Optics and Spectroscopy	25	75	100
26.	III	Core Course – CC VIII (Practical)	Practical -4	5	5	Core Practical	25	75	100
27.	III	Elective IV Generic/ Discipline Specific (	Elective IV	6	3	Allied Chemistry II Allied Chemistry Practical II	25 25	75 75	100 100
28.	**IV**	Skill Enhancement Course SEC-6 – (Naan Mudhalvan/Discipline	Paper-3	2	2	MATHEMATICAL PHYSICS	25	75	100

		Specific)							
29.	IV	Skill Enhancement Course SEC-7- (Discipline Specific)	Paper-4	2	2	Choose any one Course from A. ADVANCED MATHEMATICAL PHYSICS B. NUMERICAL METHODS AND C PROGRAMMING	25	75	100
		Sem. Total		**23**	**32**		**225**	**675**	**900**
SEMESTER V							**CIA**	**Uni. Exam**	**Total**
31.	III	Core Course – \CC IX –Theory	Paper-5	5	4	Atomic Physics and Lasers	25	75	100
32.	III	Core Course – CC X–Theory	Paper-6	5	4	Relativity and Quantum Mechanics	25	75	100
33.	III	Core Course CC -XI–Theory	Paper-7	5	4	Electricity, Magnetism and Electromagnetism	25	75	100
34.	III	Core Course – Practical/ Project with viva- voce CC -XII	Practical -5	5	4	Core Practical	25	75	100
35.	III	Elective V Generic/ Discipline Specific	Elective V	4	3	MATERIALS SCIENCE	25	75	100
36.	III	Elective VI Generic/ Discipline Specific	Elective VI	4	3	LASERS AND FIBER OPTICS	25	75	100
37.	IV	Value Education	-	2	2	Value Education	25	75	100
38.	IV	Summer Internship /Industrial Training	-	-	2	Internship /Industrial Training (Carried out in II year summer vocation) (30 hours)	100	0	100
		Sem. Total		**30**	**26**		**275**	**525**	**800**
SEMESTER VI							**CIA**	**Uni. Exam**	**Total**
39.	III	Core Course – CC XIII–Theory	Paper-8	6	4	Nuclear and Particle Physics	25	75	100
40.	III	Core Course – CC XIV–Theory	Paper-9	6	4	Solid State Physics	25	75	100
41.	III	Core Course – CC XV–Practical	Practical -6	6	4	Core Practical	25	75	100
42.	III	Elective -VII Generic/ Discipline Specific	Elective -VII	5	3	Digital Electronics and Microprocessor 8085	25	75	100
43.	III	Elective VIII Generic/ Discipline Specific	Elective - VIII	5	3	Choose any one Course from A. DIGITAL	25	75	100

						PHOTOGRAPHY B. MEDICAL INSTRUMENTATION			
44.	IV	Extension Activity	-	-	1	Extension Activity	100	-	100
45.	IV	Professional Competency Skill	-	2	2	Professional Competency Skill	100	-	100
		Sem. Total		**30**	**21**		**325**	**375**	**700**

COURSE	**THIRD SEMESTER – CORE COURSE –V (Paper-3)**
COURSE TITLE	**GENERAL AND CLASSICAL MECHANICS**
CREDITS	**5**
COURSE OBJECTIVES	This course allows the students: To have a basic understanding of the laws and principles of mechanics; To apply the concepts of forces existing in the system; To understand the forces of physics in everyday life; To visualize conservation laws; To apply Lagrangian equation to solve complex problems.

UNITS	COURSEDETAILS
UNIT-I	**LAWS OF MOTION:** Newton's Laws– forces – equations of motion- motion of a particle in a uniform gravitational field. *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 – escape velocity – potential and kinetic energy of satellite –Einstein's theory of gravitation – introduction –principle of equivalence.
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.
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:** Translational and rotational motion – angular momentum – moment of inertia – general theorems of moment of inertia – examples – rotation about fixed axis (solid and hollow sphere)– kinetic energy of rotation – examples – body rolling along a plane surface – body rolling down an inclined plane – gyroscopic precision – gyrostatic applications.
UNIT-V	**LAGRANGIAN MECHANICS:** generalized coordinates – degrees of freedom – constraints - principle of virtual work and D' Alembert's Principle –Lagrange's equation from D' Alembert's principle – application –simple pendulum – Atwood's machine.
TEXT BOOKS	1. J.C.Upadhyaya, 2019, Classical Mechanics, Himalaya Publishing house, Mumbai. 2. P.DuraiPandian, LaxmiDuraiPandian, MuthamizhJayapragasam,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
WEBLINKS	1. https://youtu.be/X4_K-XLUIB4 2. https://nptel.ac.in/courses/115103115 3. https://www.youtube.com/watch?v=p075LPq3Eas 4. https://www.youtube.com/watch?v=mH_pS6fruyg 5. https://onlinecourses.nptel.ac.in/noc22_me96/preview 6. https://www.youtube.com/watch?v=tdkFc88Fw-M 7. https://onlinecourses.nptel.ac.in/noc21_me70/preview

METHOD OF EVALUATION:

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

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

COURSE OUTCOMES	**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 COURSE –VI (Practical-3)**
COURSE TITLE	**CORE PRACTICALS**
CREDITS	5
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 (any eight experiments)

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.

- Choose minimum of any 8 experiments

METHOD OF EVALUATION:

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

COURSE	**FOURTH SEMESTER – CORE COURSE –VII (Paper-4)**
COURSE TITLE	**OPTICS AND SPECTROSCOPY**
CREDITS	**5**
COURSE OBJECTIVES	To provide an in-depth understanding of the basics of various phenomena in geometrical and wave optics; To explain the behaviour of light in different mediums; To understand the differences in the important phenomena namely interference, diffraction and Polarization and apply the knowledge in day to day life; To understand the design of optical systems and methods to minims aberrations; To solve problems in optics by selecting the appropriate equations and performing numerical or analytical calculations.

UNITS	**COURSEDETAILS**
UNIT-I	**LENS AND PRISMS:** Postulates of 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:** Types of wave front, Fresnel's biprism – fringes with white light- 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.PHIPvt Ltd, New Delhi. 4. P.R.Sasikumar, 2012, Photonics, PHIPvt Ltd, New Delhi. 5. K.Rajagopal, 2008, Engineering Physics, PHIPvt Ltd, New Delhi. 6. V.Rajendran, 2012, Engineering Physics, Tata McGraw Hill.
REFERENCE BOOKS	1. Agarwal B.S, 2011,Optics, KedernathRamnath Publishers, Meerut. 2. Sathyaprakash, 1990,Optics,VII edition, RatanPrakashanMandhir, New Delhi. 3. C.N.Banewell, 2006, Introduction to Molecular Spectroscopy,IV edition,TMH Publishing Co,New Delhi. 7. 4. AjoyGhatak, 2009,Optics, 4thedition, PHIPvt Ltd, New Delhi. 5. Singh &Agarwal,2002,Optics and Atomic Physics, 9thedition, PragatiPrakashan Meerut. 6. D.Halliday,R.Resnick and J. Walker, 2001, Fundamentals of Physics,6th edition, Willey, New York. 7. JenkinsA.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 1. 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/gammarayburst s/imagine/index.html 1. 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/

METHOD OF EVALUATION:

Continuous InternalAssessment	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**	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 –VIII (Practical-4)**
COURSE TITLE	**CORE PRACTICALS**
CREDITS	5
COURSE OBJECTIVES	Demonstrate various optical phenomena principles, working, apply with various materials and interpret the results.

LIGHT(any eight experiments)

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 Searlesgoniometer.
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 ofwire using Laser.

- Choose minimum of any 8 experiments

METHOD OF EVALUATION:

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

COURSE	FIFTH SEMESTER – CORE COURSE –IX (Paper-5)
COURSE TITLE	ATOMIC PHYSICS AND LASERS
CREDITS	4
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:** Sommerfeld'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_2 lines of sodium.
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 Easter 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

METHOD OF EVALUATION:

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

COURSE OUTCOMES:

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

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

MAPPING WITH PROGRAM OUT COMES:

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

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

COURSE	FIFTH SEMESTER – CORE COURSE X (Paper-6)
COURSE TITLE	RELATIVITY AND QUANTUM MECHANICS
CREDITS	4
COURSE OBJECTIVES	To understand the theory of relativity, its postulates and the consequences.To learn the importance of transformation equations and also to differentiate between special and general theory of relativity.To interpret the wave theory of matter with various theoretical and experimental evidences.To derive and use Schrodinger's wave equation and also learn about various operators. To solve Schrodinger's wave equation for simple problems and analyse to understand the solutions.

UNITS	COURSE DETAILS
UNIT-I	**SPECIAL THEORY OF RELATIVITY:** frames of reference – Galilean transformation – 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- Minkowski's four dimensional space.
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-Gravitational Red shift.
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 equations (Time independent and dependant) – 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:** Schrödinger's equations (Time dependant) –*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).
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, KiruthigaSivaprasath,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,RabiMajumdar, PHI, 2011. 6. Modern Physics, R. Murugesan, S.Chand& Co., New Delhi. (Quantum Mechanics,Gupta, Kumar and Sharma. Jai PrakashNath&Co Meerut 7. Quantum mechanics – Satyaprakash and Swati Saluja. KedarNath 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, AjoyGhatak and S. Lokanathan, Springer ScienceBusiness Media, Dordrecht, 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 PrakashNath&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

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**	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 COURSE XI (Paper-7)**
COURSE TITLE	**ELECTRICITY, MAGNETISM AND ELECTROMAGNETISM**
CREDITS	4
COURSE OBJECTIVES	To classify materials based on their electrical and magnetic properties. To analyse the working principles of electrical gadgets. To understand the behaviour of dc, ac and transient currents. To know about the communication by electromagnetic waves.

UNITS	**COURSE DETAILS**
UNIT-I	**CAPACITORS AND THERMO ELECTRICITY:** capacitor – principle – capacitance of spherical and cylindrical capacitors – capacitance of a parallel plate capacitor (with and without dielectric slab) – effect of dielectric –Carey Foster bridge – temperature coefficient of resistance – Seebeck effect – laws of thermo emf – Peltier effect – Thomson effect – thermoelectric diagrams –uses of thermoelectric diagrams – thermodynamics of thermo couple - determination of Peltier and Thomson coefficients.
UNIT-II	**MAGNETIC EFFECTS OF CURRENT:** Biot and Savart's law – magnetic induction due to circular coil – magnetic induction due to solenoid – Helmholtz tangent galvanometer –force on a current element by magnetic field – force between two infinitely long conductors – torque on a current loop in a field - moving coil galvanometer – damping correction – Ampere's circuital law – differential form – divergence of magnetic field – magnetic induction due to toroid.
UNIT-III	**MAGNETISM AND ELCTROMAGNETIC INDUCTION:** magnetic induction B – magnetization M - relation between B, H and M – magnetic susceptibility – magnetic permeability – experiment to draw B-H curve – energy loss due to hysteresis - Importance of hysteresis curves – Faraday and Lenz laws –vector form – self-induction – coefficient of self-inductance of solenoid – Anderson's method – mutual induction – coefficient of mutual inductance between two coaxial solenoids – coefficient of coupling - earth inductor-determination of angle of dip(Φ)
UNIT-IV	**TRANSIENT AND ALTERNATING CURRENTS:** growth and decay of current in a circuit containing resistance and inductance – growth and decay of charge in a circuit containing resistance and capacitor – growth and decay of charge in an LCR circuit (expressions for charge only) – peak, average and rms values of ac – LCR series and parallel circuits – resonance condition – Q factor – power factor.
UNIT-V	**MAXWELLS EQUATIONS AND ELECTROMAGNETIC WAVES:** Maxwell's equations in vacuum, material media– physical significance of Maxwell's equations –displacement current – plane electromagnetic waves in free space – velocity of light – Poynting vector–electromagnetic waves in a linear homogenous media – refractive index.
TEXT BOOKS	1. Murugeshan. R., - Electricity and Magnetism, 8thEdn, 2006, S.Chandand Co, New Delhi.\ 2. Sehgal D.L., Chopra K.L, Sehgal N.K., - Electricity and Magnetism, 3. Sultan Chand and Sons, New Delhi. 4. M. Narayanamurthy and N. Nagarathnam, Electricity and Magnetism, 4th Edition. 5. National Publishing Co., Meerut.

REFERENCE BOOKS	1. 1. Brijlal and Subramanian, Electricity and Magnetism, 6th Edn.,Ratanand Prakash, Agra. 2. Brijlal, N.Subramanyan and JivanSeshan, Mechanics and Electrodynamics (2005), 3. Eurasia Publishing House (Pvt.) Ltd., New Delhi. 4. David J. Griffiths, Introduction to Electrodynamics, 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

METHOD OF EVALUATION:

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

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

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

MAPPING WITH PROGRAM OUT COMES:

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

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

COURSE	**FIFTH SEMESTER – CORE COURSE XII (Practical-5)**
COURSE TITLE	**CORE PRACTICALS**
CREDITS	4
COURSE OBJECTIVES	Demonstrate various optical phenomena principles, working, apply with various materials and interpret the results.

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.

- Choose minimum of any 10 experiments

METHOD OF EVALUATION:

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

COURSE	SIXTH SEMESTER – CORE COURSE XIII (Paper-8)
COURSE TITLE	NUCLEAR AND PARTICLE PHYSICS
CREDITS	4
COURSE OBJECTIVES	To understand constituents, properties and models of nucleus.To give reason for radioactivity and study their properties.To learn about the principles of various particle detectors and accelerators. To acquire knowledge on different types of nuclear reactions and their applications.To know the reason for cosmic rays and their effect on the surface of earth and also understand the classification of elementary particles.

UNITS	COURSE DETAILS
UNIT-I	**PROPERTIES OF NUCLEUS:** 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 – evidences for 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 electron capture – internal conversion.
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 AND ELEMENTARY PARTICLES** **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

	of nucleons.
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 Pvt. Ltd., 2008) 3. Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw 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 (AcademicPress, Elsevier, 2007). 11. 13. Nuclear Physics, S. N. Ghoshal, S Chand & Co. Edition 2003 15. 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

METHOD OF EVALUATION:

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

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

COURSEOUTCOMES	**CO1**	Describe various 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 COURSE XIV (Paper-9)
COURSE TITLE	SOLID STATE PHYSICS
CREDITS	4
COURSE OBJECTIVES	To understand constituents, properties and models of nucleus. To give reason for radioactivity and study their properties. To learn about the principles of various particle detectors and accelerators. To acquire knowledge on different types of nuclear reactions and their applications. To know the reason for cosmic rays and their effect on the surface of earth and also understand the classification of elementary particles.

UNITS	COURSE DETAILS
UNIT-I	**BONDING IN SOLIDS, CRYSTAL STRUCTURE:** types of bonding –ionic bonding – bond energy of NaCl molecule –covalent bonding – metallic bonding – hydrogen bonding – Van-der-Waals bonding – crystal lattice – lattice translational vectors – lattice with basis – unit cell – Bravais' lattices – Miller indices – procedure for finding them– structures of NaCl and diamond crystals –reciprocal lattice – reciprocal lattice vectors – properties – reciprocal lattices to SC, BCC and FCC structures – Brillouin zones.
UNIT-II	**ELEMENTARY LATTICE DYNAMICS:** lattice vibrations and phonons: linear monoatomic 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 – Weidemann-Franz' law.
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'stheory of paramagnetism – Curie-Weiss law – 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.
UNIT-V	**FERROELECTRIC & SUPERCONDUCTING PROPERTIES OF MATERIALS:** *elementary band theory:*Kronig-Penny model – band gap – 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 – Applications of superconductors.

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/

METHOD OF EVALUATION:

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

COURSE OUTCOMES:

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

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

MAPPING WITH PROGRAM OUT COMES:

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

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

COURSE	**SIXTH SEMESTER – CORE COURSE XV (Practical-6)**
COURSE TITLE	**CORE PRACTICALS**
CREDITS	4
COURSE OBJECTIVES	To perform basic experiments on characteristics of electronic devices and then get into the applications such as amplifiers, oscillators, counters, multivibrators. Perform fundamental experiments on microprocessor 8085 and learn to write programs by themselves.

Electronics

1. Zener diode – voltage regulations
2. Bridge rectifier using diodes
3. Clipping and clamping circuits using diodes.
4. Characteristics of a transistor –(CE mode)
5. Characteristics of a transistor –(CB mode).
6. RC coupled CE transistor amplifier - single stage.
7. Transistor Emitter follower.
8. Colpitt's oscillator -transistor.
9. Hartley oscillator - transistor.
10. FET - characteristics.
11. FET - amplifier (common source)
12. UJT -characteristics
13. AC circuits with L,C,R -Series resonance.
14. AC circuits with L,C,R - Parallel resonance.
15. Operational amplifier - inverting amplifier and summing.
16. Operational amplifier - non-inverting amplifier and summing.
17. Operational amplifier – differential amplifier
18. Operational amplifier - D/A converter by binary resistor method.
19. 5V,IC Regulated power supply.
20. Study of gate ICs – NOT,OR,AND, NOR,NAND, XOR, XNOR
21. Verification of De Morgan's theorem using ICs –NOT, OR,AND
22. NAND and NOR as universal building blocks
23. Half adder / Half subtractor using logic gates
24. Microprocessor 8085 – addition (8 bit only) and subtraction (8 bit only)
25. Microprocessor 8085 – multiplication (8 bit only) and division (8 bit only)
26. Microprocessor 8085 – square (8 bit only)
27. Microprocessor 8085 – square root (8 bit only)
28. Microprocessor 8085 – largest/smallest of numbers (8 bit only)

- Choose minimum of any 10 experiments

METHOD OF EVALUATION:

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

DISCIPLINE SPECIFIC CORE ELECTIVES (COMPULSORY)

COURSE	**SIXTH SEMESTER – DISCIPLINE SPECIFIC ELECTIVE (Elective – VII)**
COURSE TITLE	**DIGITAL ELECTRONICS AND MICROPROCESSOR 8085**
CREDITS	3
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	**Number Systems and Boolean algebra:** decimal, binary, octal, hexadecimal numbers systems and their conversions – codes: BCD, gray and excess-3 codes –code conversions –complements (1's, 2's, 9's and 10's) –binary addition, binary subtraction using 1's & 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	**Encoder and Decoder circuits**: 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 and memory circuits**: asynchronous counters -mod-8, mod-10, synchronous - 4-bit &ring counter – general memory operations, ROM, RAM (static and dynamic), PROM, EPROM, EEPROM, EAROM.
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), subtraction (8-Bit), multiplication (8- Bit), division (8- Bit) – largest and smallest number in an array.
UNIT-V	**I/O Interfaces:** serial communication interface (8251-USART) – programmable peripheral interface (8255-PPI) - 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

METHOD OF EVALUATION:

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

DISCIPLINE SPECIFIC CORE ELECTIVES (OPTIONAL)

BASIC AND APPLIED ELECTRONICS	
Learning Objective: This course aims to provide background of the basic and applied electronics through theoretical & practical learning.	
UNITS	**COURSE DETAILS**
UNIT-I	**SEMICONDUCTING DIODES &TRANSISTORS** PN Junction Diode-Full wave Bridge Rectifier- Zener Diode-Voltage Regulated Power supply-Tunnel diode - Characteristics-Tunnel diodeas an oscillator-Construction and working of Photo diode. FET-Construction and working – FET as an amplifier-Output Characteristics and parameters of FET-MOSFET-Construction and working Principle - UJT-Equivalent circuit and V-I characteristics of UJT - UJT as relaxation oscillator.
UNIT-II	**AMPLIFIERS & OSCILLATORS** R-C coupled amplifier (Two stage)-Power amplifiers-Class A,B and C-Push-Pull amplifier- Feedback amplifier-Principles of negative feedback in amplifier-Gain of negative feedback amplifier - Sinusoidal oscillators -Circuit operation and frequency of oscillation of -Hartley, Colpitt's, Phase shift, Wein bridge and Crystal oscillator.
UNIT-III	**MULTIVIBRATORS & WAVESHAPING CIRCUITS** Multivibrators-Types of multivibrators-Transistor astable, monostable and bistable multivibrators - Differentiating and Integrating-Circuits-Clipping circuits-Positive clipper-Biased clipper-Combination clipper-Clamping circuits-Positive clamper-Negative clamper.
UNIT-IV	**INTEGRATED CIRCUITS & OP-AMP** Integrated circuit-Classification of ICs-Advantages-Limitations-Integrated circuit technology- Fabrication of Transistors, diodes, capacitors and resistors - Symbol and Terminals of an OP-AMP-Parameters- Inverting and Non-inverting amplifier - Gain-Miller effect - Virtual ground - Offset voltage - offset current - PSRR - CMRR.
UNIT-V	**OP-AMP APPLICATIONS & TIMER** OPAMP-Sign and Scale changer-Adder, subtractor and averager-Integrator and differentiator-OP AMP Logarithmic amplifier –Anti logarthmic amplifier - OP-AMP- Astable, Monostable and Bistable multivibrator - 555 Timer-Internal structure- Pin configuration of 555 Timer-555 Timer as Schmitt Trigger.
TEXT BOOKS	1.V.K.MehtaandRohitMehta,PrinciplesofElectronics, SChand & Co., NewDelhi, 2007. 2.MArulThalapathi,BasicandAppliedElectronics,Comptek,Publishers,Chennai 2005.
REFERENCE BOOKS	1.B.L.Theraja,FundamentalsofElectricalEngineeringandElectronics, SChand&Co., New Delhi, 2008. 2.R.S.Sedha,ATextBookofAppliedElectronics,SChand&Co.,New Delhi,2010. 3.V.Vijayendran,Introductionto Integrated Electronics(Digital&Analog),S. Viswanathan, Printers & Publishers Private Ltd, Chennai, 2007 4.HandBookofElectronics -Gupta&Kumar, PragatiPrakashan,Meerut, 2014.

METHOD OF EVALUATION:

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

MATHEMATICAL PHYSICS	
Learning Objective: To understand higher mathematical concepts which are applied to solve problems in Physics and similar situations	
UNITS	**COURSE DETAILS**
UNIT-I	**MATRICES:** types of matrices – symmetric, Hermitian, unitary and orthogonal matrices– characteristic equation of a matrix – Eigen values and Eigen vectors of a matrix – Cayley-Hamilton theorem – inverse of matrix by Cayley-Hamilton theorem – similarity transformations – diagonalization of 2x2 real symmetric matrices.
UNIT-II	**VECTOR CALCULUS:** vector differentiation – directional derivatives –definitions & 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 cylindrical and spherical 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. **FOURIER TRANSFORMS**: Fourier Integral theorem(Statement only)–Fourier, Fourier sine and Fourier cosine transforms,– Fourier transform of trigonometric and exponential 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.

METHOD OF EVALUATION:

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

ADVANCED MATHEMATICAL PHYSICS	
Learning Objective: The fundamentals of matrices and vector calculus learnt in earlier course will enable students to learn advanced topics and theorems. The special functions and applications of partial differential equations will be of use in research at a later stage.	
UNITS	**COURSE DETAILS**
UNIT-I	**MATRICES:** Introduction – 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:** 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.
TEXT BOOKS	1. Mathematical Physics, B.D. Gupta-Vikas Publishing House, 4 th Edition (2006) 2. Mathematical Physics, SatyaPrakash (Sultan Chand)
REFERENCE BOOKS	1. Mathematical Methods 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 (SrikrishnaPrakashan)

METHOD OF EVALUATION:

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

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

METHOD OF EVALUATION:

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

MATERIALS SCIENCE	
Learning Objective: To learn imperfections in crystals, deformation of materials and testing of materials. To get knowledge on behavior of a material, under the action of light and their applications. To know the applications of crystal defects.	
UNITS	**COURSE DETAILS**
UNIT-I	**CRYSTAL IMPERFECTIONS:** introduction – point defects: vacancies**(***problems***)**, interstitials, impurities, electronic defects – equilibrium concentration of point imperfections **(***problems***)**– application of point defects –line defects: edge dislocation**(***problems***)**, screw dislocation – surface defects: extrinsic defects – intrinsic defects: grain boundaries, tilt & 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 – viscoelastic behavior of materials – spring-Dash pot models of viscoelastic behavior of materials.
UNIT-III	**PERMANENT DEFORMATION AND STRENGTHENING METHODS OF MATERIALS:** introduction –plastic deformation: tensile stress-strain curve – plastic deformation by slip – creep: mechanism of creep – creep resistant materials – strengthening methods: strain hardening, grain refinement – solid solution strengthening – precipitation strengthening.
UNIT-IV	**OPTICAL MATERIALS:** introduction – optical absorption in metals, semiconductors and insulators – NLO materials and their applications – display devices and display materials: fluorescence and phosphorescence – light emitting diodes –liquid crystal displays.
UNIT-V	**MECHANICAL TESTING:** destructive testing: tensile test, compression test, hardness test – nondestructive testing (NDT): radiographic methods, ultrasonic methods – thermal methods of NDT: thermography – equipment used for NDT: metallurgical microscope
TEXT BOOKS	1. Material science and Engineering,Raghavan V, Prentice Hall of India, Sixth Edition, 2015 2. Materials science, V. Rajendran, McGraw Hill 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, Butterworth & 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.

METHOD OF EVALUATION:

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

LASERS AND FIBER OPTICS	
Learning Objective: The students will learn the fundamentals, types of lasers, laser instrumentation and their applications also the interconnect 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–Theoryof mode locking– cavity dumping.
UNIT-II	**TYPES OF LASER: s**olid state laser: ruby laser, Nd:YAGlaser– semiconductor laser: intrinsic semiconductor laser, doped semiconductorlaser, injection laser – dye laser – chemical laser: HCL laser. Gas laser: neutral atom gas laser (He-Ne laser), CO_2 laser, 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, NewDelhi. 2. AnIntroductiontolaser,theoryandapplicationsbyAvadhunulu, M.N.S.,Chand&Co,NewDelhi 3. J.WilsonandJ.F.B. Hawkes.'IntroductiontoOptoElectronics', PearsonEducation, 2018.
REFERENCE BOOKS	1. A.Sennaroglu,"PhotonicsandLaserEngineering:Principles,DevicesandApplications"McGraw-HillEducation,2010. 2. K.R.Nambiar,"Lasers:Principles,TypesandApplications",NewAgeInternational,2004. 3. Optic, AjoyGhatak, McGraw-HillEducation(India)Pvt,Ltd, 6thEdn., 2017.

METHOD OF EVALUATION:

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

DIGITAL PHOTOGRAPHY	
Learning Objective: To understand the principles of photography and image formation and the science and arts behind it. To understand the essential components of conventional and digital cameras and also the different image processing techniques.	
UNITS	**COURSE DETAILS**
UNIT-I	**PHOTOGRAPHY AND BASIC PRINCIPLE OF IMAGE FORMATION:** principle –chemical route and digital route –light, wavelengths, colours – shadows – light intensity and distance – making light form images –pin-hole images – practical limitations to pin-hole images – lens instead of pin-hole – focal length and image size – imaging of closer subjects.
UNIT-II	**LENSES – CONTROLLING THE IMAGES:** photographic lens – focal length and angle of view **(***problems***)** – focusing movement – aperture and f-numbers **(***problems***)** – depth of field– depth of focus – image stabilization – lenses for digital cameras – lens and camera care.
UNIT-III	**CAMERA USING FILMS AND ITS TYPES:** camera and its essential components– shutter – aperture – light measurement – film housing – camera types: view camera– view finder camera – Reflex camera– single lens reflex (SLR) camera.
UNIT-IV	**DIGITAL CAMERAS PRINCIPLE AND TYPES:** principle of digital image capturing –comparison of digital and analog picture information – megapixel – grain, noise and pixel density – optical and digital zooming – image stabilizer – bit depth – white balance – colour modes – file formats (TIFF, RAW & JPEG) – storage cards and types – digital cameras: camera phones – compact camera – hybrid camera – digital SLR.
UNIT-V	**THE DIGITAL IMAGE – POSTPRODUCTION:** hardware: computer and its peripherals – software: saving digital file – basic editing: navigating the image – undo/redo/history – crop – rotate – brightness &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

METHOD OF EVALUATION:

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

MEDICAL INSTRUMENTATION	
Learning Objective: This course aims to provide background of the Physics principles inmedical 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 – radiopharmaceuticals – technetium generator – gamma camera – positron emission tomography – disposal of radioactive waste.
UNIT-IV	**ULTRASOUND IMAGING:** ultrasound transducer – ultrasound imaging– Doppler ultrasound – ultrasound image quality & 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. KuppusamyThayalan (2017), Basic Radiological Physics 2nd Edn. Jaypee Brothers Medical Publishers (P) Ltd, New Delhi.
REFERENCE BOOKS	1. John Webster (2004) Bioinstrumentation John Wiley and Sons, Singapore. 2. John Enderle, Susan Blanchard, Joseph Bronzino (2005) Introduction to Biomedical Engineering, 2nd ed. Elsevier, San Deigo 3. William Hendee, Geoffrey Ibbott, Eric Hendee (2005) Radiation therapy Physics 3rd ed. Wiley-Liss, New Jersey

METHOD OF EVALUATION:

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

NON MAJOR ELECTIVES (NME)

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

METHOD OF EVALUATION:

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

NANOSCIENCE AND NANOTECHNOLOGY	
Learning Objective: This course aims to provide an overall understanding of Nanoscience and Nanotechnology and introduces different types of nanomaterials, their properties, fabrication methods, characterization techniques and a range of applications.	
UNITS	**COURSE DETAILS**
UNIT-I	**NANOSCIENCE AND NANOTECHNOLOGY:** nanoscale– nature and nanostructures – nanostructures: 0D, 1D,2D– surface to volume ratio– size effect – excitons – quantum confinement– metal based nanoparticles (metal and metal oxide) – nanocomposites (non-polymer based) – carbon nanostructures – fullerene –SWCNT and MWCNT
UNIT-II	**PROPERTIES OF NANO-MATERIALS:** introduction –mechanical behavior –elastic properties – hardness and strength – ductility and toughness –superplastic behavior – optical properties – surface plasmon resonance – electrical properties – dielectric materials and properties – magnetic properties – super para magnetism – electrochemical 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 – sol-gel methods – synthesis of CNT.
UNIT-IV	**CHARACTERIZATION TECHNIQUES:**scanning probe microscopy – scanning tunneling microscopy – atomic force microscopy – scanning electron microscopy – transmission electron microscopy –powder XRD method: determination of structure and grain size analysis – UV-visible and photoluminescence spectroscopy.
UNIT-V	**APPLICATIONS OF NANOMATERIALS:** medicine: drug delivery – photodynamic therapy – molecular motors –energy: fuel cells – rechargeable batteries – supercapacitors– photovoltaics. sensors: nanosensors based on optical and physical properties – electrochemical sensors- nanoelectronics: CNTFET – display screens – GMR read/write heads – nanorobots.
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 Nanotechnology, Universities Press.

METHOD OF EVALUATION:

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