Uka Tarsadia University

B.Tech.

CE / IT / AI & DS / CYBER SECURITY / CE (SE) / CSE / CSE (CC) / CSE (AI&ML) / CSE (CS)

Semester I

PHYSICS

PY3028

EFFECTIVE FROM July-2024
Syllabus version: 1.00

Subject Code	Subject Title
PY3028	Physics

Teaching Scheme				Examination Scheme			
Hours		Credits		Theory Marks		Practical Marks	Total Marks
Theory	Practical	Theory	Practical	Internal	External	CIE	
3	2	3	1	40	60	50	150

Objective of the course:

- To provide students with a comprehensive understanding of the principles, applications, and practical skills relevant to the laser, optical fiber, crystallography, semiconductor, superconductor, wave, Electromagnetic wave, quantum mechanics and nanotechnology.

Course Outcomes:

At the closing stage of the course, the students will be able to,

CO1: Understand the principle of laser and optical fiber, their properties, types and applications.

CO2: Understand the fundamentals of crystallography and examine the X-ray diffraction principles and application in material analysis.

CO3: Understand the overview of semiconductor theory, P-N junction diode and solar cell operations. Study the various properties of superconductor and correlate with its applications.

CO4: Investigates different types of waves and their velocity. Also study superposition principle of wave and its consequence.

CO5: Understand properties of electromagnetic wave using Maxwell's equations and examine law of conservation of energy and momentum using it.

CO6**:** Understands the basic principles of quantum mechanics and overview of different nanoparticles and their characterization methods.

Sr. No.	Topic	Hours
	Unit– I	
1	**Laser:** Introduction, Spontaneous and stimulated emission, Einstein's coefficients, Pumping, Population inversion, Principle, He-Ne and Ruby lasers its applications, Introduction of Masers and Holography. **Optical Fiber:** Introduction, construction and its types, principle, input and output characteristics of optical fiber, Dispersion and Attenuation in optical fibers, Optical sensors and Optical fiber communication.	8

	Unit– II	
2	**Solid State Physics:** Introduction, Space lattice, Basis, Unit cell, Lattice parameter, Bravais lattices, Crystal systems, Structure and packing fractions of simple cubic, Body centered cubic and Face centered cubic crystals, Directions and planes in crystals, Miller indices, Separation between successive (hkl) planes, Diffraction of X-rays by crystal planes, Bragg's law, Free electron theory, Fermi energy, Fermi-Dirac distribution function, Density of states, Kronig-Penny model (qualitative), Concept of effective mass – Electrons and holes	7
	Unit– III	
3	**Semiconductors:** Distinction between conductors, semiconductors and insulators on the basis of energy band theory, classification of semiconductors, P and N type of semiconductors, Determination of energy gap in semiconductors, formation of P-N junction, Hall effect, Solar cell and its working, Concept of optoelectronics and devices. **Superconductor:** Introduction, Critical temperature, Properties of superconductors, Type of superconductors, Comparison between I & II superconductors, High T_C superconductors, BCS Theory (qualitative), Application of Superconductors.	8
	Unit– IV	
4	**Waves:** Transverse and longitudinal waves, Transverse wave on a string, The wave equation on a string, Harmonic waves, Reflection and transmission of waves at a boundary, Impedance matching, Superposition of waves and Fourier method, Wave velocity and particle velocity, Standing waves and their Eigen frequencies, Longitudinal waves and the wave equation for them, Acoustics waves and speed of sound.	7
	Unit– V	
5	**Electromagnetic Wave:** Maxwell's equations in vacuum and medium, Electromagnetic waves and its equation, Hertz's discovery, Transverse nature of electromagnetic waves, The pointing vector, Momentum and radiation pressure.	7
	Unit–VI	
6	**Introduction to Quantum Physics:** Wave particle duality – Black body radiation, Photoelectric effect, Pair production process and Compton effect, Concept of de Broglie's Matter waves, Electron double slit experiment, Heisenberg's Uncertainty principle and Commutators,	8

	Nonexistence of an electron in the nucleus, Concept of phase velocity and group velocity, Concept of wave function Ψ and interpretation of $\|\Psi\|^2$, Schrödinger's time dependent/independent equation, Applications of Schrödinger's equation (qualitative treatment) – Particle in one dimensional rigid box. **Introduction to Nanotechnology:** Significance of the nanoscale, Nanoscale surface to volume ratio, Surface effects on nanomaterial's, Nanomaterials classification, Quantum size effects, Electron confinement, Synthesis approach of nanoparticles (qualitative), Applications of nanomaterials.	

Sr. No.	Physics (Practicals)	Hours
1	Study of Error and its types. Significant figure. Fluctuations and Noise in measurement system. S/N ratio and Noise figure. Data analysis using least square fitting.	2
2	Measurements of length (or diameter) using Vernier caliper, screw gauge and travelling microscope.	2
3	To study the Hall effect.	2
4	To determine the energy band gap in a semiconductor using a p-n Junction diode.	2
5	Determination of wavelength of LASER light using diffraction grating.	2
6	To find the numerical aperture and acceptance angle of optical fiber.	2
7	Study of P-N junction - Determination of Reverse Saturation Current Io and Material Constant η.	2
8	Study of solar cell characteristics (I-V) and study of series and parallel combination.	2
9	To plot I-V (Current-Voltage) Characteristics of Silicon P-N Junction Diode. To find cut-in Voltage (Threshold Voltage) for Silicon P-N Junction diode.	2
10	To determine resonance and velocity of sound by open and closed pipe.	2
11	To measure the resistivity of a semiconductor with temperature by four-probe method and to determine its band gap.	2
12	The Photoelectric Effect; photo current versus intensity and wavelength.	2
13	Radiation from a black body: Stefan-Boltzmann Law.	2
14	Standing (Transverse) Waves and resonance Using Vibrating Strings, Melde's Experiment.	2
15	To determine value of Planck's constant using LEDs of at different colors.	2
	*Minor project is compulsory at the end of semester	

Text book:

1. G. Vijayakumari, "Engineering Physics", Vikas Publication.

Reference books:

1. M.C. Jain, "Quantum mechanics", PHI learning.
2. Arthur Beiser, "Concept of Modern Physics", Mc Graw Hill Education.
3. Walker, Halliday and Resnick, "Principle of Physics", 10th Edition, Wiley Publication.
4. Griffith, "Introduction to Electrodynamics", Pearson Publication.
5. Narindra Kumar, "Physics for Engineers", Laxmi Publication LTD.
6. M.N.Avadhanulu and P.G.Kshirsagar, "A Text Book of Engineering Physics", 9th Revised Edition, S.Chand Publication.

Course objective and Course outcomes mapping:

- To provide students with a comprehensive understanding of the principles, applications, and practical skills relevant to the laser, optical fiber, crystallography, semiconductor, superconductor, wave, electromagnetic wave, quantum mechanics and nanotechnology: CO1, CO2, CO3, CO4, CO5, CO6.

Course units and Course outcome mapping:

Unit No.	Unit	Course Outcomes					
		CO1	CO2	CO3	CO4	CO5	CO6
1	Laser and Optical Fiber	√					
2	Solid State Physics		√				
3	Semiconductors and superconductor			√			
4	Waves				√		
5	Electromagnetic Wave					√	
6	Introduction to Quantum Physics and Nanotechnology						√

Programme Outcomes:

PO 1: Engineering knowledge: An ability to apply knowledge of mathematics, science, and engineering.

PO 2: Problem analysis: An ability to identify, formulates, and solves engineering problems.

PO 3: Design/development of solutions: An ability to design a system, component, or process to meet desired needs within realistic constraints.

PO 4: Conduct investigations of complex problems: An ability to use the techniques, skills, and modern engineering tools necessary for solving engineering problems.

PO 5: Modern tool usage: The broad education and understanding of new engineering techniques necessary to solve engineering problems.

PO 6: The engineer and society: Achieve professional success with an understanding and appreciation of ethical behavior, social responsibility, and diversity, both as individuals and in team environments.

PO 7: Environment and sustainability: Articulate a comprehensive world view that integrates diverse approaches to sustainability.

PO 8: Ethics: Identify and demonstrate knowledge of ethical values in non-classroom activities, such as service learning, internships, and field work.

PO 9: Individual and team work: An ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give/receive clear instructions.

PO 11: Project management and finance: An ability to demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Programme Outcomes and Course Outcomes mapping:

Programme Outcomes	**Course outcomes**					
	CO1	CO2	CO3	CO4	CO5	CO6
PO1	✓	✓	✓	✓	✓	✓
PO2	✓	✓	✓	✓	✓	✓
PO3	✓				✓	✓
PO4	✓	✓	✓	✓	✓	✓
PO5	✓		✓		✓	✓
PO6						
PO7						
PO8						
PO9						
PO10						
PO11						
PO12						