Code: APPH100	Physics I	L-T-P-CR-CH: 3-1-0-4-4

Prerequisites: Physics at 10+2 level

Course Objectives

CO1. To understand and apply the principles of mechanics, optics, electromagnetic theory, quantum mechanics, waves, and oscillations, as well as solid-state and semiconductor physics, in solving problems and analyzing physical phenomena.

CO2. To analyze and interpret experimental data from various topics, including optics, quantum mechanics, and solid-state physics, and draw meaningful conclusions about the underlying physical principles.

CO3. To develop problem-solving skills using mathematical and conceptual tools to tackle problems in physics and engineering.

CO4. To relate theoretical concepts in physics to real-world applications, such as optical instruments, electromagnetic devices, semiconductor technology, and quantum systems, demonstrating an understanding of the practical significance of physical principles.

Learning Outcomes

Upon the completion of the course, the students will be able to:

LO1. Demonstrate a thorough understanding of the fundamental principles of mechanics, optics, electromagnetic theory, quantum mechanics, waves, and oscillations, as well as solid-state and semiconductor physics.

LO2. Apply mathematical tools, including vector algebra and calculus, to solve problems in physics, including those involving curvilinear coordinate systems, electromagnetic waves, and quantum mechanics.

LO3. Analyze and interpret physical phenomena, including optical experiments, electromagnetic waves, and quantum systems, and draw meaningful conclusions about the underlying physical principles.

LO4. Relate physical concepts to practical applications, including optical instruments, electromagnetic devices, semiconductor technology, and quantum systems, demonstrating an understanding of the practical significance of physical principles.

SYLLABUS

Unit 1: Mechanics (8 lectures)

Curvilinear coordinate systems, concepts of potential energy, conservative and non-conservative forces, angular momentum and rotational motion, non-inertial frames of reference.

Unit 2: Waves and oscillations (6 lectures)

Simple harmonic motion, damped and forced simple harmonic oscillator, quality factor, applications in mechanical and electrical systems, power absorbed by oscillator, wave groups and group velocity.

Unit 3: Electromagnetic Theory (8 lectures)

Vector algebra and vector calculus, basics of electrostatics and magnetostatics, displacement current, Maxwell's equations, continuity equation for current densities, Maxwell's equation in vacuum, energy in an electromagnetic field, the electromagnetic wave equation, plane electromagnetic waves in vacuum, their transverse nature and polarization.

Unit 4: Optics (6 lectures)

Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection. Young's double slit experiment, Newton's rings, Michelson interferometer, Fraunhofer diffraction from a single slit.

Unit 5: Quantum Mechanics (8 lectures)

Photoelectric effect, Compton effect, electron diffraction, wave nature of particles and the Schrodinger equation, Born interpretation, expectation values, uncertainty principle, application of Schrodinger equation: particle in a box, harmonic oscillator.

Unit 6: Solid state, semiconductor physics (6 lectures)

Crystal structure, free electron theory of metals, density of states, electronic band-structure, intrinsic and extrinsic semiconductors, equilibrium carrier statistics, carrier generation and recombination, carrier transport: diffusion and drift, p-njunction, LED, Solar cells.

Total **(42 lectures)**

Text Books:

1. An Introduction to Mechanics, Daniel Kleppner and Robert J. Kolenkow, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1999.
2. Optics. E. Hecht and A. R. Ganesan, Pearson Education, 5th Edition, 2019.
3. Introduction to Electrodynamics. D. J. Griffiths, Cambridge University Press, 4th Edition, 2017.
4. Introduction to Quantum Mechanics. D. J. Griffiths, Cambridge India, 2nd Edition, 2016.
5. Quantum Physics. R. Eisberg and R. Resnick, John Wiley and Sons, 2nd Edition, 1985.
6. Semiconductor Optoelectronics: Physics and Technology. J. Singh, McGraw-Hill Inc., New York, 1995.
7. Vibration and Waves: The MIT Introductory Physics Series. A. P French, W. W. Norton & Company, New York, 1971.
8. Introduction to solid state physics. C. Kittel, Wiley, 8th Edition, 2012.
9. Semiconductor Physics and Devices. D. A. Neamen, 4th Edition, McGraw-Hill Education, 2021.