Minor Elective-1
MNE1201
Fundamentals of Modern Physics (4-0-0)

Pre-requisites: Basic knowledge of physics at 10^{th} level.

Course Objectives

This course is designed to strengthen the basic modern physics concepts essential for engineering students, focusing on quantum physics and the atomic structure and spectra. It aims to provide students with a solid understanding of fundamental physical laws, their application to problem-solving, and the relevance of physics to the world around them. The course will help students develop the knowledge required for various engineering applications

Course Outcomes

CO1	Understanding the fundamental principles of quantum mechanics.
CO2	Apply quantum physics concepts to explain atomic structures, energy levels, and atomic spectra, crucial for fields like materials science and photonics.
CO3	Develop the ability to solve complex physics problems using modern physics principles.
CO4	Understand how quantum mechanics explains the connection between microscopic behaviours and macroscopic properties, vital for semiconductor technology.
CO5	To apply modern physics principles in real-world engineering and technological innovations.

Unit	Title of Unit	Topics	Lectures
I	Basics elementsof Modern Physics	Black body radiation; Photoelectric effect; Compton effect. de Broglie waves, Wave particle Duality, Davisson- Germer experiment (electron diffraction experiment), Matter waves, Particle and wave packets, Uncertainty principle.	**10**
II	Wave Properties of Electron	Wave function, Schrodinger's time independent equation and its Applications- Particle trapped in a 1-D box and 3-D box. Expectation values, Potential barrier and Quantum tunneling effect.	**8**
III	Atomic & Molecular Spectra	Hydrogen atom (radial equation), Brief idea of Atomic and molecular spectra (rotational, vibrational and rotational-vibrational spectra of diatomic molecules), Introduction to Laser, laser systems (He-Ne and Ruby Lasers) and applications	**7**

IV	Applications of Modern Physics-I	Introduction to Solid State Physics & Devices: Band theory of Solids Conductors, insulators and semi-conductors; Halleffect	**8**
V	Applications of Modern Physics-II	Intrinsic and Extrinsic semiconductors; Temperature variation of Fermi energy, p-n junction and Transistor; Introduction to Superconductivity and types of superconductors	**7**
		Total	**40**

Suggested Readings:

Textbooks:

1. Concepts of Modern Physics A. Beiser
2. Modern Physics by P.A. Tipler and R.A. Liewellyn.
3. Physics for Scientists and Engineers Raymond A. Serway and John W. Jewett
4. Physics: Principles with Applications Douglas C. Giancoli

Reference books:

5. Modern Physics: for Scientist and Engineers by John Morrison, Publisher:Academic Press; 1st edition.

6. University Physics with Modern Physics by Hugh D. Young, Roger A. Freedmanand Lewis Ford.

7. Solid State Physics, Solid State Device and Electronics by C M Kachhava, NewAge International, 2003.

Outcome of the Course:

This course is designed so that the students learn basic and essential concepts of Modern Physics with some of its main applications, which may be further useful for higher learning in different branches of engineering and develop analytical and problem-solving skills for variety of problems. On completion of this course, the students will be able to develop understanding for variety of areas in the physics including quantum physics, atomic and molecular spectroscopy and solid-state physics/devices. Furthermore, this course will further help students to understand the fundamental physics behind the emerging areas of physics such as lasers and superconductors.