22PY105 SEMICONDUCTOR PHYSICS AND ELECTROMAGNETICS

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Basics of vectors and semiconductors.

COURSE DESCRIPTION AND OBJECTIVES:

This course ensures commensurable understanding of electrostatics and magneto statics. It enunciates the electron dynamics in solids through the conceptual grasp of principles of quantum mechanics. This embark perspective outlook on optoelectronic devices and optical fibres in the backdrop of semiconductor physics.

MODULE-1

UNIT-1 **10L+0T+10P = 20 Hours**

ELECTROSTASTICS AND MAGNETOSTASTICS:

Electrostatics: Introduction to Vector analysis, Computation of electric field and potential due to Point charge, linear charge density, surface charge density, bulk charge density, Coulomb's law, Electric field due to line of charges, Gauss law, Differential Form of Gauss law, Applications, Electric field due to a charged sphere – inside, on the surface, and outside, Electric field due to a spherical shell- inside and outside.

Magnetostatics: Introduction to magnetic force – Lorentz force, Biot-Savart's law, Magnetic field due to a linear conductor – magnetic field due to a circular loop –Ampere's law, Faraday's law in integral form; Lenz's law, Maxwell's equations – correction to Ampere's law.

UNIT-2 **6L+0T+6P = 12 Hours**

QUANTUM MECAHNICS AND FREE ELECTRON THEROY:

Quantum mechanics: Introduction to Quantum mechanics; Concepts of wave and particle duality of radiation; de Broglie's concepts of matter waves, Schrödinger's time-independent wave equation – Eigen values and Eigen functions; Particle confined in a one-dimensional infinite Potential square well.

Free electron theory of solids: Classical and Quantum free electron theory of metals; Fermi- Dirac distribution; Density of states – derivation -Bloch's Theorem (Qualitative); Classification of solids based on energy bands.

PRACTICES:

- Photoelectric effect-Determination of plancks constant.
- Stewart & Gee's Experiment- Study of magnetic field along the axis of a current carrying coil.
- Melde's Experiment - determination of the frequency of tuning fork.
- Hall Effect - Determination of Hall coefficient.

MODULE-2

UNIT-1 **8L+0T+8P = 16 Hours**

SEICONDUCTOR PHYSICS AND OPTOELECTRONICS:

Introduction, Classification of Semiconductors, Direct and indirect band gap semiconductors, Intrinsic semiconductors; Variation of Intrinsic carrier concentration with temperature, Fermi level, and conductivity; Extrinsic semiconductor, the effect of temperature on carrier concentration in extrinsic semiconductors, Band diagrams of extrinsic semiconductors; Hall effect, Classification of optoelectronic devices; Photo voltaic cell, LED.

SKILLS:

- ✓ *Able to compute the electric and magnetic field and potentials in different applications*
- ✓ *Apply the quantum laws to understand the electron dynamics of solids*
- ✓ *Realizing the importance of optoelectronic devices*

UNIT-2 **8L+0T+8P = 16 Hours**

LASERS AND OPTICAL FIBERS:

Introduction to lasers, Population inversion & pumping processes, Semiconductor diode laser, Applications of lasers. Optical fiber-Numerical Aperture, types of optical fibres, Fiber optic communication system.

PRACTICES:

- Laser - Determination of wavelength.
- Optical fibre - Determination of Numerical aperture – Acceptance angle.
- Determination of Energy Band gap of p-n junction diode.
- LED - Determination of Threshold Voltage of LED.
- Solar cell – Determination of Fill factor & efficiency.

COURSE OUTCOMES:

Upon successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply Maxwell's equations to unravel electron dynamics in amidst of electric and magnetic fields.	Apply	1	1, 2, 4, 5, 9, 10
2	Comprehend the knowledge of Lasers and optical fibers to conceive their applications in vivid domains.	Apply	2	1, 2, 3, 5, 9, 10
3	Discriminate solids based on principles of quantum mechanics.	Analyse	1	1, 2, 3, 4, 9, 10
4	Assessment of semiconductors in the perspective of optoelectronic devices.	Evaluate	2	1, 3, 4, 5, 6, 9, 10

TEXT BOOKS:

1. S.O. Pillai, "Solid State Physics", New age International publishers, 8th edition, 2018.
2. H.C. Varma, "Classical Electromagnetism", Bharathi Bhavan Publication, 2022.

REFERENCEBOOKS:

1. D. Halliday, R. Resnick and J. Walker, "Fundamentals of Physics", 6th edition, John Wiley and Sons, New York, 2001.
2. M.N. Avadhanulu, "Engineering Physics", S. Chand publications 2010.
3. Charles Kittel, "Introduction to Solid State Physics", 7th edition, Wiley, Delhi, 2007.
4. Donald A. Neamen, "Semiconductor Physics and Devices: Basic Principle", 4th edition, McGraw-Hill, New York, 2012.
5. David J. Griffiths, "Introduction to Electrodynamics", 3rd edition, Prentice Hall of India, New Delhi, 2012.
6. N.W. Ashcroft and N.D. Mermin, "Solid State Physics", International student edition, Brooks Cole, 2008.