22PY104 PHYSICS FOR ELECTRONIC ENGINEERS

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Basics of bonding in solids, electrostatics and magnetostatics.

COURSE DESCRIPTION AND OBJECTIVES:

The aim of this course is to have insight into crystal Physics, principles of quantum mechanics and electron dynamics of solids from the perspective of optoelectronic devices. This provides seamless consolidation of electromagnetics towards establishment Maxwell's equations and their applications.

MODULE-1

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

INTRODUCTION TO CRYSTAL PHYSICS:

Lattice points and Space lattice; Basis and crystal structure; Unit Cell – Primitive cell and Lattice parameters; Crystal Systems and Bravais lattices; Packing factor for SC, BCC, and FCC; Miller Indices – Distance of separation between successive (hkl) planes; X- ray diffraction – Bragg's law- Powder Crystal Method; Classification of defects – Point defects.

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

QUANTUM THEORY OF SOILDS AND FREE ELECTRON THEORY OF METALS:

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- Particle confined in a one-dimensional infinite Potential square well; 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:

- Laser - Determination of wavelength.
- Determination of Planck's constant.
- Melde's Experiment - determination of the frequency of tuning fork.
- Determination of Energy Band gap of p-n junction diode.

MODULE-2

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

ELECTROMAGNETICS:

Electrostatics: 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.

SKILLS:

- ✓ *To distinguish various crystals and the orientation of crystal planes*
- ✓ *To apply the principles of quantum mechanics to understand electron dynamics of solids*
- ✓ *To interpret the knowledge of electric and magnetic fields in view of electronic devices*
- ✓ *To appraise the utilization of optoelectronic devices*

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

OPTOELECTRONICS:

Introduction to optoelectronics; Photovoltaic effect – construction and working of solar cell – Electroluminescence -construction and working of Light emitting diode – Stimulated emission - construction and working of diode laser, Photodiodes – classification of Photodiodes PIN-Avalanche types and applications.

PRACTICES:

- Hall Effect - Determination of Hall coefficient.
- Stewart & Gee's Experiment- Study of magnetic field along the axis of a current carrying coil.
- Solar cell – Determination of Fill factor & efficiency.
- LED - Study of V-I characteristics.

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 the knowledge of crystal geometry to distinguish solids	Apply	1	1, 2, 3, 12
2	Interpret the electromagnetic laws to demonstrate the functioning of electric and electronic devices	Apply	2	1, 3, 4, 5, 12
3	Analyse the performance of optoelectronic devices based on their construction	Analyse	2	1, 2, 3, 4, 10, 12
4	Evaluate electron dynamics based on quantum principles	Evaluate	1	1, 2, 3, 10, 12

TEXT BOOKS:

1. S.O. Pillai, "Solid State Physics", New age International publishers, 8th edition, 2018.
2. H.P. Myers, "Introduction to Solid State Physics", Taylor & Francis, 2009.

REFERENCEBOOKS:

1. D. Halliday, R. Resnick and J. Walker, "Fundamentals of Physics", 6th edition, John Wiley and Sons, New York, 2001.
2. Charles Kittel, "Introduction to solid state physics", 7th edition, Wiley, Delhi, 2007.
3. Donald A. Neamen, "Semiconductor Physics and Devices: Basic principle", 4th edition, McGraw-Hill, New York, 2012.
4. David J. Griffiths, "Introduction to Electrodynamics", 3rd edition, Prentice Hall of India, New Delhi, 2012.
5. N.W. Ashcroft and N.D. Mermin, "Solid State Physics", International student edition, Brooks Cole, 2018.