Semiconductor Physics and Electrodynamics

F.Y.B.Tech. (E-group) Semester II

Course code: PH-19003 (SPE)

Teaching Scheme

Lectures : 3hrs/week

Practical : 2hrs/week

Examination Scheme

Test 1: 20 & Test 2: 20 marks

End Sem Exam: 60 Marks

Unit 1 **[7 Hrs]**

Band theory of Solids

Band theory of solids, Classification of solids on the basis of band theory, Fermi-Dirac probability function, Electron and hole concentrations in semiconductors, Position of Fermi level in intrinsic and extrinsic semiconductors.

Unit 2 **[8 Hrs]**

Semiconductor conductivity

Intrinsic density, Intrinsic conductivity, Extrinsic conductivity, Law of mass action, Temperature variation of carrier concentration in extrinsic semiconductors, Electrical conduction in extrinsic semiconductor, Diffusion length and mean life time, Hall Effect.

Unit 3 **[6 Hrs]**

Semiconductor devices

Formation of p-n junctions, position of Fermi level in equilibrium, forward and reverse bias, p-n junction diode: I-V charateristics in forward and reverse bias, Solar Cell.

Unit 4 **[7 Hrs]**

Dielectrics

Introduction, Nonpolar molecules, Polar molecules, Polar and nonpolar molecules in an electric field, Electric polarization of matter, Electric polarization vector, Electric field in dielectrics, Gauss's law in dielectrics, Relation between three electric vectors D, E and P, Effect of dielectric on capacitance.

Unit 5 **[7 Hrs]**

Electromagnetics

Differential and integral calculus: Operator, Concept of gradient, divergence and curl. Line, surface and volume integrals, Gauss–Divergence theorem, Stokes theorem, Equation of continuity, Divergence of magnetic induction, Biot Savart's law, Ampere's circuital law.

Unit 6 **[7 Hrs]**

Electrodynamics

Faraday's law of electromagnetic induction, generalization of amperes law, Maxwell's equations, Electromagnetic wave equations, Maxwell's wave equation for free space, Velocity of electromagnetic wave.

References:

1. Engineering Physics, Avadhanulu and Kshirsagar.
2. Classical Electrodynamics, J. D. Jackson, Wiley Publishers.
3. Introduction to Electrodynamics, D. J. Griffiths, Springer Publication.
4. Concepts of Modern Physics, Arthur Beiser, Tata McGraw – Hill Edition.
5. Solid State Physics, A. J. Dekkar, Mac Millan India Limited.
6. Solid State Physics, Neil W. Ashcroft and N. David Mermin, Thomson Books Cole.
7. Fundamentals of Magnetism, B. Cullity, Addison-Wesley Publishing.
8. Semiconductor Devices, Physics and Technology, S. M. Sze Wiley.
9. Solid State Physics, S O Pillai, New Age International.
10. Introduction to Solid State Physics, Charles Kittel, Wiley.

Course Outcomes:

Student will be able to understand:

- Understand the band theory of solids and the carrier concentration in solids..
- The charge distribution and charge transfer process in semiconductors.
- The intrinsic and extrinsic conductivity to design semiconductor devices.
- The fundamentals of electromagnetism.
- Understand the electric polarization and identify the dielectrics for device study.
- Understand the electrodynamics and use Maxwell's equations for solving problems.

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