

Department of Physical Sciences

15PH201 Physics of Materials

(Common to EC, EE, EI, CS and IT)

3 0 2 4

Course Objectives

By enrolling and studying this course the students will be able to

- explore the physical properties of conductors, superconductors and semiconductors
- classify the types of dielectric and magnetic materials and polarization mechanisms in dielectrics with properties
- grasp the basic principles of light interaction with matter and working of optical devices

Program Outcome (POs)

1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and engineering specializations to the solution of complex engineering problems

Course Outcomes (COs)

On successful completion of the course, the students will be able to

- use the conducting, superconducting and semiconducting materials for specific applications
- analyze the properties of dielectric and magnetic materials for the development of appropriate appliances
- infer the optical characteristics of materials and understand the mechanism involved in optical devices

Unit I Conducting and superconducting materials

Electrical and thermal conductivity of metals - Wiedemann-Franz law - band theory of metals - density of states. Superconductors: properties - types - high temperature superconductors-applications. **10 Hours**

Unit II Semiconductors

Elemental and compound semiconductors. Intrinsic semiconductors: carrier concentration - electrical conductivity - band gap. Extrinsic semiconductors: carrier concentration - variation of Fermi level with temperature. Hall effect: theory and experimental determination - applications: solar cells. **10 Hours**

Unit III Dielectric Materials

Types of polarization: Expressions for electronic and ionic polarizations - orientation and space charge polarization mechanisms (qualitative) - Langevin-Debye equation - frequency



and temperature effects on polarization - dielectric strength and loss - Local field - Clausius-Mossotti relation - dielectric breakdown mechanisms - active dielectric materials: piezo, pyro and ferroelectricity - applications.

10 Hours

Unit IV Optical Materials

Interaction of light with materials - optical absorption - transmission - Luminescence in solids - Fluorescence and Phosphorescence - Optical band gap - LED -LCD.

7 Hours

Unit V Magnetic Materials

Classification and properties - domain theory - hard and soft magnetic materials - anti-ferro and ferri magnetic materials - applications: magnetic recording and memories.

8 Hours

Unit VI* Smart materials

Photonic crystals - LIFI

References

1. Saxena, Gupta, Saxena, Mandal, Solid State Physics, Pragati Prakashan Educational Publishers, 13th revised edition, Meerut, India, 2013.
2. M.N. Avadhanulu and P.G. Kshirsagar, A Text Book of Engineering Physics, S. Chand & Company Ltd., New Delhi, 2011.
3. S. O. Pillai, Solid State Physics, New Age International Publications, New Delhi, 2010.
4. M.A. Wahab, N.K. Mehta, Solid state physics-structure and properties of materials, Narosa publishing house Pvt. Ltd, 6th edition, 2010.
5. Semiconductor Physics and Devices, Donald A. Neamen , Mc Graw-Hill, 2011.
6. P.K. Palanisamy, Materials Science, Scitech Publications India Pvt. Ltd, 2014.

* Self Study/ Seminar Presentation