

PPH327: ELECTROMAGNETIC PROPERTIES OF MATERIALS

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Course Objectives: The course aims at to introduce the behaviour of materials in external electric and magnetic field to the students.

Introduction: Interaction of free electrons with lattice, Brillouin zones, Nearly free electron model, Tight binding and other electronic structure models.

Conducting Materials: Electrical resistivity of metals and alloys, Mattheissen rule, Nordheims Rule, Kondo effect, Ionic and superionic conductors, Properties and their applications.

Dielectric and Insulating Materials: Polarization, ClausiusMosotti equation, Dielectric permittivity and loss, Dielectric break down in materials, High K dielectric materials, Non-linear dielectrics, Ferroelectricity, Piezoelectricity, Pyroelectricity, Actuators and Smart materials.

Magnetic Materials: Classification, Ferromagnetism and Exchange interactions, Ferromagnetic domains, Magnetic anisotropy, Magnetic behaviour of polycrystalline materials, Hard and soft magnetic metallic and Intermetallic materials and their characteristics, Their properties and applications, Magnetism and superconductivity, Magnetostriction.

Course Learning Outcomes (CLO):

Students will have understanding of:

1. process of electrical conduction in different types of conductors.
2. behaviour of insulators in external electric field.
3. origin of magnetism in materials.

Recommended Books:

1. Kittel, C, *Introduction to Solid State Physics*, John Wiley & Sons, Inc., (1996).
2. Ashcroft, N.W., and Mermin, N.D., *Solid State Physics*, Thomson, (2007).
3. L. Solymar and Walsh, *Lectures on Electrical Properties of Materials*, Oxford University Press, (2004).
4. Hummel, R.E., *Electronic Properties of Materials*, Springer Verlag, (2004).