

4. ELECTRICAL, ELECTRONICS AND MAGNETIC BEHAVIOR OF MATERIALS

Module I (7 Hours)

Introduction: Classification of electrical materials: conductors, semiconductors, dielectrics, superconductors, their types and applications.

Electrical Properties: High voltage conducting materials, High and low resistance materials. Contact fuse and filament materials, Conductors, cable & wire materials, Solder, sheathing and sealing materials, Electrical properties, Factors affecting electrical conductivity, Wiedemann-Franz law, Lorentz number, thermoelectric properties

Module II (9 Hours)

Electronic Properties: Types of semiconductors, Semiconductor compounds and alloys and their properties. Materials for different devices. Ruby laser, Semiconductor laser and other lasers etc. Optoelectronics LED materials, LCD materials, Photo conductive materials, optical fibre etc. Dielectric Properties: Dielectric constant, Dielectric strength and dielectric loss. Polarizability, Mechanism of polarization, Behaviour of polarization under impulse and frequency switching. Ferroelectrics, Piezoelectrics, Pyroelectrics, Electrostriction effect. Types of dielectric materials, Clausius - Mosotti equation.

Module III (9 Hours)

Magnetic Properties: Origin of magnetism, Basic terms and properties. Types of magnetic materials. Laws of magnetic materials. Domain theory, Domain growth & domain wall rotation. Magnetic anisotropy. Ferromagnetic domains. Magnetostriction & its mechanism. Ferrites, spinels & garnets. Hard and soft magnetic materials. Textured magnetic materials, Oxide magnetic materials. Magnetic tape, Magnetic bubble, Magnetic glasses, High energy hard magnetic materials, Recent developments.

Module IV (11 Hours)

Superconductivity : Phenomenon, properties of superconductors, Meissner effect, Critical magnetic field & critical temperature, Types of superconducting materials- Type I & II superconductors, Silsbee rule, mechanism of super conduction, BCS theory, Debye temperature. London's & Glog theories, High temperature ceramic superconductor applications: MRI, Maglev, MHD etc.

Materials for Specific Applications: Materials for instruments, transducers, consumer electronic items, alternators, generators, transformers, computers etc

Compact Characterization : Groupings of characteristics, Microstructural features, Pore characterization, Mechanical properties, Surface properties, Physical properties etc.

Text and Reference Books:

1. L. Solymar, D. Walsh, 'Electrical Properties of Materials', Oxford University Press, USA, 2004. ,
2. David C. Jiles, 'Introduction to the Electronic Properties of Materials', Taylor and Francis, 200 I.
3. D.C. Jiles, 'Introduction to Magnetism and Magnetic Materials', Springer, 1990.
4. Manijeh Razeghi, 'Optoelectronic Materials and Device Concepts', SPIE-International Society for Optical Engine, 1991.
5. Rose R.M., Shepard L.A., Wulff J., 'Structure and Properties of Materials', Volume IV, 'Electronic Properties', 4th Edition, 1984.
6. K.M. Gupta, 'Electrical Engineering Materials', 3rd Edition, Umesh Publication, Delhi, 2005.

7. B.D. Cullity, 'Introduction to Magnetic Materials', Addison-Wesley publishing company, California, London, 1972.
8. A. Goldman, 'Modern Ferrite Technology', Van Nostrand, New York, 1990.
9. J.P. Jakubovics, 'Magnetism and Magnetic Materials', Institute of Materials, London, 1994.
10. Tareev B., 'Physics of Dielectric Materials', MIR, 1975.
11. Rolf E. Hummel, 'Electronic Properties of Materials', Springer, 2004.
12. Safa O. Kasap, 'Principles of Electronic Materials and Devices', McGraw-Hill, 2005.
13. Irene, 'Electronic Materials Science', Wiley-Interscience, 2006.
14. Jasprit Singh, 'Smart electronic materials: Fundamentals and Applications', Cambridge University Press, 2005.
15. M.E. Lines, A.M. Glass, 'Principles and Applications of Ferroelectrics and Related Materials', Oxford University Press, USA, 2001.
16. Dekker A.J., 'Solid State Physics', Macmillan India, 1995.
17. Robert C., O' Handley, 'Modern Magnetic Materials: Principles and Applications', Wiley-Interscience, 1999.