MSE-467 Electronic, Magnetic and Optical Materials

Credit Hours: 2-0

Pre-requisites: Nil

Course Description

This course provides a detailed understanding of the basic principles governing the behavior of materials with specific physical properties such as electronic, magnetic, and optical properties. It explores the complex relationships existing between the atomic, electronic and crystal structure of materials and their macroscopic properties. The special emphasis will be on the applications of these materials in different industries.

Course Contents

- Classification and concept of Electrical and Electronic Materials. Metallic materials and their electrical properties. Semiconductor materials and their electrical properties. Semiconductor devices. Ceramic materials used in electronic applications.
- Magnetic materials and their classification. Magnetization curve, hysteresis loop. Types of magnetic behavior. Ferromagnetic domains. Experimental evidence for domains. Domain wall motion. Hindrances to wall motion. Soft Magnetic Materials: Desirable properties for soft magnetic materials. Potential applications of soft magnetic materials. Hard Magnetic Materials: Properties of Hard magnetic materials. Origin of Ferromagnetism in Rare Earth based permanent magnets. Potential applications of permanent magnets.
- Characteristics of optical materials, Types of optical materials.

Weekly Plan

Week	Topics
1	Classification and concept of Electrical and Electronic Materials
2	Metallic materials and their electrical properties. Semiconductor materials and their electrical properties
3	
4	Semiconductor devices
5	Ceramic materials used in electronic applications.
6	Magnetic materials and their classification. Magnetization curve, hysteresis loop. Types of magnetic behavior. Ferromagnetic domains. Experimental evidence for domains. Domain wall motion
7	
8	
9	**Mid-Semester Exams**

10	Hindrances to wall motion. Soft Magnetic Materials: Desirable properties for soft magnetic materials
11	
12	Potential applications of soft magnetic materials. Hard Magnetic Materials: Properties of Hard magnetic materials
13	
14	Origin of Ferromagnetism in Rare Earth based permanent magnets. Potential applications of permanent magnets
15	Characteristics of optical materials, Types of optical materials
16	
17-18	**End Semester Exams**

Course Outcomes

At the end of the course, students will be able to:

- Describe the fundamentals of electrical, magnetic, and optical materials.
- Characterize and analyze different properties of electrical, magnetic and optical materials.
- Select different electrical, magnetic, and optical materials for a given application.

Suggested Books

- Fundamentals of Materials Science and Engineering by W. D. Callister, D. G. Rethwisch: An Integrated Approach. 5th ed. Wiley (2018)
- Foundations of Materials Science and Engineering by W. F. Smith, J. Hashemi. 7th ed. Mc Graw Hill (2022)
- The Science and Engineering of Materials by D. R. Askeland, W. J. Wright. enhanced 7th ed. Cengage Learning (2020).
- Optical Materials by K. S. Potter, J. H. Simmons. 2nd ed. Elsevier (2021)