Materials Science Centre
Indian Institute of Technology Kharagpur

Detailed syllabus of course

Course Code: To be filled later (NEW course) Breakup: 3-0-0

Course Name: **Fundamentals of Electronic Materials**

Objective: The objective of this course is to familiarize the undergraduate and post-graduate students on several basic characteristics of material that plays important role in its performance in various applications. In this course, students would also learn on synthesis/deposition and processing of several electronic materials. This course is useful for the students who want to pursue their career in the materials, electronics, and semiconductors fields.

Course Details:

Unit-I: Structure of Materials: The nature of the bond, crystalline and amorphous materials, crystal structure, structure and classification of metals, ceramics and polymers

Unit-II: **Defects in Materials:** Crystalline defects – point defects, line defects, planar defects and bulk defects, concentration of defects, their influence on properties

Unit-III: Thermodynamics of Materials: Phase equilibria, Gibbs phase rule, introduction to phase diagrams

Unit-IV: Diffusion: Ficks Laws of Diffusion, atomistic model of diffusion, influence of temperature, concentration,

Unit-III: Electrical Conduction in Materials: Resistivity, Drude Theory, Hall Effect, Introduction to Band Theory and Band Structure, Influence of defects and impurities, ionic conduction, conduction in polymers

Unit-IV: Dielectric Properties of Materials: Dielectric behavior and breakdown of dielectrics, ferroelectric, piezoelectric behaviours.

Unit-V: Optical Properties of Materials: Absorption, Transmission and Reflection in materials, Colour and its causes, emission and detection of light, LEDs, lasers, etc.

Unit-VI: Magnetic Properties of Materials: origins of magnetism, ferromagnetism, ferrimagnetism, anti-ferromagnetic behavior, paramagnetism, diamagnetism, superconductivity.

Unit VII: Types of electronic materials: An overview of metallic materials, ceramic materials, polymeric materials and their uses as active and passive components in electronics.

Unit-VIII: Processing of Electronic Materials: conventional semiconductor processing – oxidation, lithography, etching, ion implantation, etc, thin film evaporation, CVD, MBE, processing of organic and polymeric materials for electronics, roll-to-roll processing techniques, 3D-printing, solution processing,

Pre-requisite: None

Reference books

1. Principles of Electronic Materials and Devices by Safa O. Kasap, McGraw Hill (2005)
2. Fundamentals of Materials Science and Engineering - An Integrated Approach by William Callister Jr. and David Rethwisch, Wiley (2012)
3. Electronic Properties of Materials by Rolf Hummel, Springer (2011)
4. Polymer Electronics, by Mark Geoghegan and Georges Hadziioannou, Oxford, (2013)