

## Course Syllabi: UES012 Engineering Materials (L : T : P :: 3 : 1 : 2)

1. **Course number and name:** UES012 Engineering Materials

2. **Credits and contact hours:** 4.5 and 6

3. **Text book, title, author, and year**

### **Text Books / Reference Books**

- *W.D. Callister , Materials Science and Engineering; John Wiley & Sons, Singapore, 2002.*
- *W.F. Smith, Principles of Materials Science and Engineering: An Introduction; Tata Mc-Graw Hill, 2008.*
- *V. Raghavan, Introduction to Materials Science and Engineering; PHI, Delhi, 2005.*
- *S. O. Kasap, Principles of Electronic Engineering Materials; Tata Mc-Graw Hill, 2007.*
- *L. H. Van Vlack, Elements of Material Science and Engineering; Thomas Press, India, 1998.*
- *K. G. Budinski, Engineering Materials – Properties and selection, Prentince Hall India, 1996.*
  - a. Other supplemental materials
    - Nil

4. **Specific course information**

a. Brief description of the content of the course (catalog description)

**Structure of solids:** Classification of engineering materials, Structure-property relationship in engineering materials, Crystalline and non-crystalline materials, Miller Indices, Crystal planes and directions, Determination of crystal structure using X-rays, Inorganic solids, Silicate structures and their applications. Defects; Point, line and surface defects.

**Mechanical properties of materials:** Elastic, Inelastic and Viscoelastic behaviour, Engineering stress and engineering strain relationship, True stress - true strain relationship, review of mechanical properties, Plastic deformation by twinning and slip, Movement of dislocations, Critical shear stress, Strengthening mechanism and Creep.

**Equilibrium diagram:** Solids solutions and alloys, Gibbs phase rule, Unary and binary eutectic phase diagram, Examples and applications of phase diagrams like Iron - Iron carbide phase diagram.

**Electrical and magnetic materials:** Conducting and resistor materials, and their engineering application; Semiconducting materials, their properties and applications; Magnetic materials, Soft and hard magnetic materials and applications; Superconductors; Dielectric materials, their properties and applications. Smart materials: Sensors and actuators, piezoelectric, magnetostrictive and electrostrictive materials.

**Corrosion process:** Corrosion, Cause of corrosion, Types of corrosion, Protection against corrosion.

**Materials selection:** Overview of properties of engineering materials, Selection of materials for different engineering applications.

### **Laboratory Work and Micro-Project:**

Note: The micro-project will be assigned to the group(s) of students at the beginning of the semester. Based on the topic of the project the student will perform any of the six experiments from the following list:

- To determine Curie temperature of a ferrite sample and to study temperature dependence of permeability in the vicinity of Curie temperature.
- To study cooling curve of a binary alloy.
- Determination of the elastic modulus and ultimate strength of a given fiber strand.
- To determine the dielectric constant of a PCB laminate.
- Detection of flaws using ultrasonic flaw detector (UFD).
- To determine fiber and void fraction of a glass fiber reinforced composite specimen.
- To investigate creep of a given wire at room temperature.
- To estimate the Hall coefficient, carrier concentration and mobility in a semiconductor crystal.
- To estimate the band-gap energy of a semiconductor using four probe technique.
- To measure grain size and study the effect of grain size on hardness of the given metallic specimens.

#### **5. Specific goals for the course**

After the completion of the course, the students will be able to:

- Classify engineering materials based on its structure.
- Draw crystallographic planes and directions.
- Distinguish between elastic and plastic behavior of materials.
- Distinguish between Isomorphous and eutectic phase diagram.
- Classify materials based on their electrical and magnetic properties.
- Propose a solution to prevent corrosion.

#### **6. Brief list of topics to be covered**

- Structure of solids
- Mechanical properties of materials
- Equilibrium diagram
- Electrical and magnetic materials
- Corrosion process
- Materials selection