

2012 (A)

MATERIAL SCIENCE AND  
ENGINEERING MATERIALS

Time : 3 hours akubihar.com Full Marks : 70

## Instructions :

- (i) The marks are indicated in the right-hand margin.
- (ii) There are **TEN** questions in this paper.
- (iii) Attempt any **FIVE** questions.

1. (a) Give the comparison among ionic, covalent and metallic bonds. 7
- (b) What effect would you expect in different types of bonds on strength, ductility and conductivity? 7
2. (a) Define a space lattice. What are its important characteristics? 6
- (b) Describe briefly the following with neat sketches : 8
  - (i) BCC structure
  - (ii) FCC structure
  - (iii) HCP structure
  - (iv) Miller indices

3. (a) Show from the fundamental principle, the atomic packing factor for FCC and BCC structures are 0.74 and 0.68 respectively. Also determine its coordination number. 8
- (b) Copper has an FCC structure and an atomic radius of 1.278 Å. Calculate its density. Atomic weight of copper is 63.5 and Avogadro's number =  $6.023 \times 10^{23}$ . 6
4. (a) Define and explain briefly the following terms giving suitable sketches : 8
  - (i) Point defects
  - (ii) Line defects
  - (iii) Schottky defects
  - (iv) Edge and screw dislocations
  - (v) Burger's vector akubihar.com
- (b) What is the difference between impurities and alloying elements? Name a few impurities present in steel. 6
5. (a) Distinguish clearly among the conductor, semiconductor and insulator of electricity using the energy band diagram model. 7
- (b) What is a semiconductor? Name the various semiconductor materials. What is the difference between n-type and p-type semiconductors? 7

6. (a) Distinguish between soft magnetic material and hard magnetic material. Give a few examples of each type indicating their composition and applications. 8
- (b) Draw a typical  $B-H$  curve for ferro-magnetic material and explain the significance of nature of the curve. 6
7. (a) Explain the basic mechanism involved in solid solution hardening and give examples of alloys strengthened by this process. akubihar.com 7
- (b) How does the plastic deformation in polycrystalline metals differ from that of single crystal? 7
8. Draw the complete iron-carbon phase diagram and discuss briefly the structure and properties of steel having 0.83% and 0.43% carbon when cooled from 1000 °C to room temperature. 14
9. Explain the following : 14
- (a) Why is martensite so hard and brittle?
- (b) Why is damping capacity of ductile iron better than steel?

- (c) Why is glass used mostly as reinforcement material for composites?
- (d) Why continuous cooling of plain carbon steel does not show bainite in its microstructure?
10. (a) Give the composition, properties and uses of the following alloys : 8
- (i) High-speed steel
- (ii) Silicon steel
- (iii) Stainless steel
- (iv) Vanadium steel
- (v) Tungsten steel akubihar.com
- (b) What are the commercial alloys of aluminium? Briefly describe their composition and uses. 6

★ ★ ★

akubihar.com