Code: AE04 **Subject: MATERIALS AND PROCESSES**
Time: 3 Hours **Max. Marks: 100**

JUNE 2011

NOTE: There are 9 Questions in all.

- **Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.**
- **The answer sheet for the Q.1 will be collected by the invigilator after 45 Minutes of the commencement of the examination.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1 Choose the correct or the best alternative in the following: **(2 × 10)**

a. The coordination number of Simple Cubic and HCP unit cells is

(A) 12, 12. **(B)** 6, 12.
(C) 8, 12. **(D)** 12, 8.

b. Which of the following elements is a covalently bonded crystal?

(A) Aluminium **(B)** sodium chloride
(C) Germanium **(D)** lead

c. Miller indices of the diagonal plane of a cube are

(A) (220). **(B)** (110).
(C) (010). **(D)** (101).

d. The residual stress and incomplete penetration in welding can be reduced by

(A) Preheating the parts to be welded and quickly cooling the welded structure
(B) Preheating the parts to be welded and slowly cooling the welded structure
(C) Slowly cooling the welded structure only
(D) Quickly cooling the welded structure only

e. P-type and N-type extrinsic semiconductors are formed by adding impurities of valency

(A) 5 and 3 respectively. **(B)** 5 and 4 respectively.
(C) 3 and 5 respectively. **(D)** 3 and 4 respectively.

f. The property of a material by which it can be drawn into wires is known as

(A) Softness **(B)** malleability
(C) Ductility **(D)** tempering

g. A ferromagnetic material is one in which neighbouring atomic magnetic moments are

(A) antiparallel and unequal.
(B) predominantly parallel.
(C) all randomly oriented.
(D) predominantly parallel in a small region of material.

h. Which of the relation gives the diffusion constant D_n for electron if μ_n is the mobility for electron, T is the temperature and K_B is Boltzmann's constant

(A) $Dn = \frac{2 \times K_B \times T \times \mu_n}{e}$ **(B)** $Dn = \frac{2 \times K_B \times \mu_n}{e \times T}$

(C) $Dn = \frac{2 \times K_B \times T}{e \times \mu_n}$ **(D)** $Dn = \frac{K_B \times T \times \mu_n}{e}$

i. Steel can be hardened by which of the following process

(A) Normalizing **(B)** Annealing
(C) Quenching **(D)** All of the above

j. The dielectric strength is highest in

(A) PVC. **(B)** Polyethylene.
(C) Mica. **(D)** Transformer oil.

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2 a. A metal having a cubic structure has a density of 1.892 gm/cm^3, an atomic weight of 132.91 gm/mol, and a lattice parameter of 6.13 A°. One atom is associated with each lattice point. Determine the crystal structure of the metal. **(8)**

b. Does the Burger's vector change with the size of the Burgers circuit? Explain. **(8)**

Q.3 a. The density of a sample of HCP beryllium is 1.844 gm/cm^3 and the lattice parameters are $a_o = 0.22858$ nm and $C_o = 0.35842$ nm. Calculate
(i) the fraction of the lattice points that contain vacancies
(ii) the total number of vacancies in a cubic centimetre. **(8)**

b. What is tie-line rule? Explain. Show that, for correct mass balance, the relative amount of two co-existing phases or micro constituents must be as given by the lever rule. **(8)**

Q.4 a. What are the characteristics of a semiconducting material? Discuss the properties of Silicon and germanium, as well as their uses. **(8)**

b. How the mobility of carrier current is related to Hall coefficient? Is the mobility of an electron in the conduction band of a semiconductor the same as the mobility of a hole in the valence band? **(8)**

Q.5 a. Show that the electrical conductivity in metals is proportional to the density of free electrons and to the electron mobility. **(8)**

b. What are Manganin and Nichrome? Give their composition, properties and uses. **(8)**

Q.6 a. Explain the electric polarization, the electric susceptibility, dielectric loss and loss angle in the context of dielectrics. **(8)**

b. Give the properties and classification of ferrites. Differentiate magnetically soft ferrites and magnetically hard ferrites. **(8)**

Q.7 a. How the magnetic behavior of magnetic materials are classified. List their properties to distinguish them from each other. **(8)**

b. A magnetic material has a coercive field of 167 A/m, a saturation magnetization of 0.616 Tesla, and a residual inductance of 0.3 tesla. Sketch the hysteresis loop for the material. **(8)**

Q.8 a. Discuss atomic model of diffusion. What is Einstein's relationship? **(8)**

b. Differentiate between chemical vapour deposition and lithography **(8)**

Q.9 Write short notes on any **TWO**: **(8+8)**

(i) Cold and Hot working processes
(ii) Welding, soldering, and brazing processes
(iii) Full Annealing and Normalizing
(iv) Hardening and tempering.