

Code: AE04

Subject: MATERIALS AND PROCESS

AMIETE – ET (OLD SCHEME)

Time: 3 Hours

DECEMBER 2011

Max. Marks: 100

NOTE: There are 9 Questions in all.

- Please write your Roll No. at the space provided on each page immediately after receiving the Question Paper.
- 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 interplanar spacing of the first reflecting plane in an FCC crystal is

- (A) $a\sqrt{3}$ (B) $a/\sqrt{3}$
 (C) $a/\sqrt{2}$ (D) a

b. A cation vacancy and an anion vacancy in a crystal of a type AB is called

- (A) Schottky defect (B) Frenkel defect
 (C) Pair of vacancies (D) none of these

c. The degree of freedom when ice, water and water vapour co-exist in equilibrium is

- (A) 1 (B) triple point
 (C) 0 (D) -1

d. Fick's second law for unidirectional flow under non steady state conditions is

- (A) $\frac{\partial c}{\partial t} = -D \frac{\partial^2 c}{\partial x^2}$ (B) $\frac{\partial c}{\partial t} = D \frac{\partial^2 c}{\partial x^2}$
 (C) $\frac{\partial c}{\partial t} = -D \frac{\partial c}{\partial x}$ (D) $\frac{\partial c}{\partial t} = D \frac{\partial c}{\partial x}$

e. The probability of occupation of an energy level E, when $E - E_F = KT$, is given by

- (A) 0.73 (B) 0.63
 (C) 0.27 (D) 0.5

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- f. The energy gap in diamond is
- (A) 5.4 eV (B) 2-3 eV
(C) 1.1 eV (D) 0.08 eV
- g. Among the common dielectric materials, the highest dielectric strength is possessed by
- (A) Mica (B) Transformer oil
(C) PVC (D) Polyethylene
- h. The temperature of the antiferromagnetic-to-paramagnetic transition is called
- (A) Antiferromagnetic Curie temp (B) Curie-Weiss temp
(C) Neel temp (D) Debye temp
- i. The grown single crystal generally contains
- (A) tilt boundaries
(B) twin boundaries
(C) grain boundaries
(D) dislocation loops due to vacancy condensation
- j. The magnetic moment of a ferric ion in nickel-zinc ferrite is
- (A) 5 (B) 0
(C) 2.2 (D) depends on Zn %

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

- Q.2** a. Draw the curve between potential energy and distance of separation between atoms in bonds. Discuss effect of temperature on mean spacing between atoms. (8)
- b. Discuss triangular coordination of anions around a cation in ionic bonds. Find critical radius ratio for triangular coordinations. (8)
- Q.3** a. What is edge dislocation? Show that the Burgers vector is parallel to the screw dislocation line. (8)
- b. Explain Lever rule & Gibbs phase rule with example. (8)
- Q.4** a. Explain interstitial and vacancy diffusion based on atomic model of diffusion. (8)
- b. Differentiate between Hardening and Tempering, based on change in mechanical properties, process and applications. (8)

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- Q.5** a. Differentiate between HOT & COLD working and discuss their effects on mechanical properties of metals. (8)
- b. Explain Czochralski process of single crystal growth. (8)
- Q.6** a. Discuss the properties of conducting materials used for electrical contacts and heating elements. (8)
- b. Calculate the energy difference between the $n_x = n_y = n_z = 1$ level and the next higher energy level for free electrons in a solid cube of 10 mm dimension. (8)
- Q.7** a. Draw Fermi level diagram of P-N junction in forward and reverse bias. Write the applications of junction transistor. (8)
- b. Compare N-type & P-type semi conductors. Write any three elements that you would add to pure crystal of Si to make it
- (i) N-type and
- (ii) P-type extrinsic semiconductors. (8)
- Q.8** a. What is ionic polarizability? Explain effect of temperature and frequency over polarization. (8)
- b. Explain concept of Ferroelectricity and piezoelectricity. Write the properties and applications of piezoelectric materials. (8)
- Q.9** a. The saturation magnetization of BCC iron is 1750 KA/m. Calculate the net magnetic moment per iron atom in the crystal. (8)
- b. What are hard magnetic materials? Write properties and applications of alnico and ferrites. (8)