## December 2005

**Code: A-04** 

0.1

**Subject: MATERIALS AND PROCESSES** 

Time: 3 Hours Max. Marks: 100

**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.
- 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.

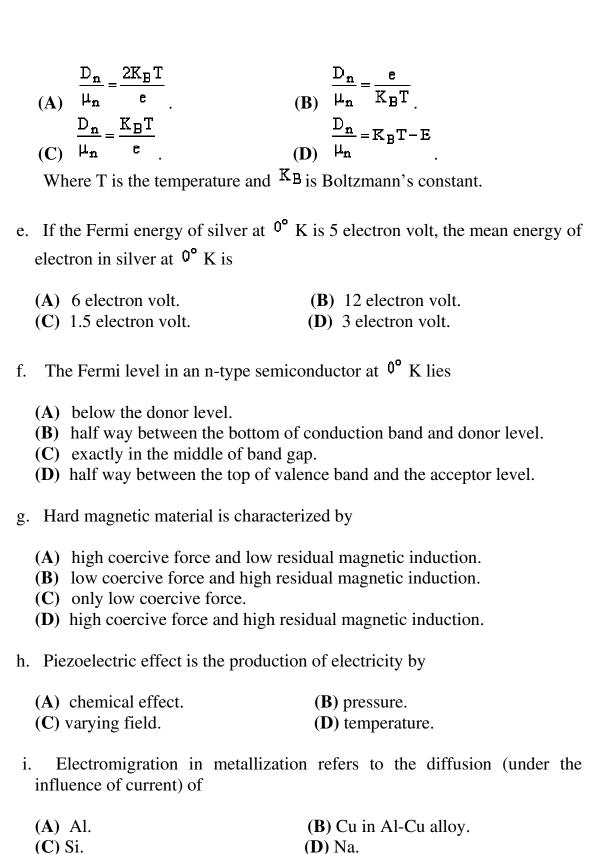
	following:	(2x10)
a	a. The number of atoms present in the unit cell of hcp stru	
	(A) 2.	<b>(B)</b> 4.
	( <b>C</b> ) 6.	<b>(D)</b> 7.
b	b. Metallic bond is not characterized by	
	(A) ductility.	<b>(B)</b> high conductivity.
	(C) directionality.	( <b>D</b> ) opacity.

c. Frankel and Schottky imperfections are

Choose the correct or best alternative in the

- (A) dislocations in ionic crystals.
- (B) grain boundaries in covalent crystals.
- (C) vacancies in ionic crystals.

- (**D**) vacancies in co-valent crystals.
- The Einstein relationship between the diffusion constant, D<sub>n</sub> and mobility,  $\mu_n$  for electron is



j. Fine grain sizes are obtained by

(A) slow cooling.

- **(B)** increasing nucleation rate.
- (C) decreasing growth rate.
- (**D**) fast cooling.

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

- Q.2 a. Why a covalent bond is directional? Describe the salient features of ionic and metallic bonded crystals. (3+7)
  - b. Obtain the Miller indices of a plane which intercepts at a, <sup>b</sup>/<sub>2</sub>, 3c in a simple Cubic unit cell. Draw a neat diagram showing the plane. (Where a, b, c are lattice parameters). (4+2)
- Q.3 a. 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. (3+5)
  - b. What are the different types of point defects? How are they caused? (6+2)
- Q.4 a. State and explain Fick's laws of diffusion. What are the factors influencing the diffusion coefficient? (8+2)
  - b. How do temperature and impurities affect electrical resistivity of metals? (6)
- **Q.5** a. Define mobility of a carrier of current. How is it related to the Hall coefficient? Is the mobility of an electron in the conduction band of a semiconductor the same as the mobility of an electron (or hole) in the valence band? Give reasons for your answer. **(10)** 
  - b. The resistivity of pure silicon at room temperature is 3000 ohmm. Mobilities of electrons and holes in silicon are  $0.14 \text{ m}^2 \text{v}^{-1} \text{s}^{-1}$  and  $0.05 \text{ m}^2 \text{v}^{-1} \text{s}^{-1}$  respectively. Calculate the intrinsic carrier density of silicon at room

temperature. (6

- Q.6 a. What are properties of an ideal electrical insulating material? What are the various products and applications of mica? (3+5)
  - b. What is dielectric strength? Explain the various causes & processes which give rise to different types of dielectric break down. (2+6)
- Q.7 a. What are the most important properties of permanent magnetic materials? Explain. (6)
  - b. What are ferrites? Where are they used? Give examples. Differentiate magnetically soft ferrites and magnetically hard ferrites. (2+4+4)
- Q.8 a. What is the basis of classification of hot and cold working? What are the advantages and disadvantages of cold working over hot working? (4+5)
  - b. What are the functions of oxide layer in a high quality IC? Explain. (7)
- Q.9 a. Explain the process of extrusion. What are its applications? (8)
  - b. What are the objectives of heat treatment processes? Describe the hardening process and explain its various stages. (8)