

Subject: MATERIALS & 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. Magnesium crystallizes in HCP structure. If the lattice constant is 0.32 nm, the nearest neighbour distance in magnesium is

- (A) 0.64 nm (B) 0.32 nm
(C) 0.16 nm (D) 0.8 nm

b. The atomic bond in NaCl is

- (A) Ionic (B) metallic
(C) covalent (D) Vander Waals

c. If the mobility of electrons in a metal increases, the resistivity

- (A) decreases
(B) increases
(C) first decreases and then increases
(D) first increases and then decreases

d. Fick's first law of diffusion is applicable under

- (A) steady state conditions of mass flow
(B) non-steady state conditions
(C) steady as well as non-steady state conditions
(D) none of the above

e. Which one is the wrong anode-cathode combination?

- (A) Zinc-Iron (B) Nickel-Titanium
(C) Iron-Tin (D) Silver-zinc

f. Which one of the following materials does not has permanent magnetic dipoles?

- (A) ferromagnetic (B) antiferromagnetic
(C) paramagnetic (D) diamagnetic

g. A suitable material for audio and TV-transformers is

- (A) Pure iron (B) Ferrite
(C) Iron and 30% Ni alloy (D) Fe and 4% Si alloy

h. The width of the depletion layer of a junction

- (A) is independent of applied voltage
(B) is increased under reverse bias.
(C) decreases with light doping
(D) increases with heavy doping.

i. At 0°K , all the valence electrons in an intrinsic semiconductor

- (A) are in the valence band (B) are in the forbidden gap
(C) are in the conduction band (D) are free electrons

j. Polarization in a dielectric on application of electric field is

- (A) Passing of current through dielectric.
(B) Breaking of insulation
(C) Displacement/separation of opposite charge centres.
(D) Excitation of electrons to higher energy level.

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

- Q.2** a. Show that the atomic packing factor for BCC is 0.68. (8)
b. Calculate the force of attraction between a Ca^{2+} and an O^{2-} ion the centers of which are separated by a distance of 1.5 nm. (8)
- Q.3** a. Briefly describe how polymer can classified into the four general types of molecular structures. (8)
b. FCC lead (Pb) has a lattice parameter of 0.4949 nm and contains one vacancy per 500 Pb atoms. Calculate the density and the number of vacancies per gram of Pb. (8)
- Q.4** a. Explain the Kirkendall effect. (8)
b. Show that the Fermi level in an intrinsic semiconductor lies in the middle of the conduction and valence bands. (8)
- Q.5** a. Consider a parallel-plate capacitor having an area of $6.45 \times 10^{-4} \text{ m}^2$ and a plate separation of $2 \times 10^{-3} \text{ m}$ across which a potential of 10 V is applied. If a material having a dielectric constant of 6.0 is positioned within the region between the plates, compute the dielectric displacement D and the polarization. (8)

- b. Explain the following:
- (i) polarizability.
 - (ii) dipole relaxation.
 - (iii) loss angle.
 - (iv) dielectric breakdown.

Summarize the various factors contributing to breakdown in dielectrics. (8)

Q.6 a. What are ferromagnetic materials? How the domains are formed and influenced by temperature changes? (8)

- b. Briefly describe the phenomenon of magnetic hysteresis. Explain why repeatedly dropping a permanent magnet on the floor will cause it to become demagnetized. (8)

Q.7 a. Some metal alloy is known to have electrical conductivity and electron mobility values of $1.2 \times 10^7 (\Omega\text{-m})^{-1}$ and $0.0050 \text{ m}^2/\text{V-s}$, respectively. Through a specimen of this alloy that is 35 mm thick is passed a current of 40 A. What magnetic field would be required to be imposed to yield a Hall voltage of $-3.5 \times 10^{-7} \text{ V}$. (8)

- b. Explain process of oxidation, diffusion and metallisation, during the fabrication of a semiconductor device. (8)

Q.8 a. Draw and explain the V-I characteristics of tunnel diode. (8)

- b. Write short note on carbon resistors, metal film resistors and wire wound resistors? (8)

Q.9 a. Define the terms wafer, chip, device, integrated circuit, and surface mount. Why is silicon the most commonly used semiconductor in IC technology? (6)

- b. Identical JFETs characterized by $I_G=0$, $I_{DSS}=10 \text{ mA}$ and $V_{PO}=4 \text{ V}$ are connected as shown in Fig.. Let $R_D=1 \text{ k ohm}$, $R_S=2 \text{ k ohm}$ and $V_{DD}=15 \text{ V}$, Find (i) V_{GSQ1} (ii) I_{DQ2} (iii) V_{GSQ2} (iv) V_{DSQ1} and (v) V_{DSQ2} .

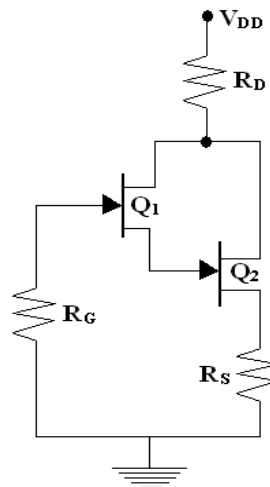


Fig. 1

(10)