

Subject: MATERIALS & PROCESSES

Time: 3 Hours

Max. Marks: 100

DECEMBER 2010

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 half an hour 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 minimum number of ions in the unit cell of an ionic crystal with FCC space lattice are
- (A) 16 (B) 12
(C) 8 (D) 2
- b. If r be the radius of the atom in a crystal crystallizing in the simple cubic structure, then the nearest neighbour distance is
- (A) $8r$ (B) $4r$
(C) $2r$ (D) r
- c. Hydrogen bonds are stronger than
- (A) ionic bonds (B) metallic bonds
(C) covalent bonds (D) Vander Waals bonds
- d. Which of the following metals has the lowest temperature coefficient of resistance?
- (A) Silver (B) Gold
(C) Copper (D) Aluminium
- e. In photoelectric effect the number of electrons emitted is proportional to
- (A) work function of cathod (B) velocity of incident beam
(C) frequency of incident beam (D) intensity of incident beam
- f. The composition of manganin alloy is
- (A) 60% Cu, 10% Mn, 30% Ni (B) 80% Cu, 10% Mn, 10% Ni
(C) 80% Cu, 20% Mn (D) 60% Cu, 15% Mn, 25% Ni

g. Magnetic induction B and magnetic field intensity H are related by

- (A) $B = \mu_0 + \mu_0 H$ (B) $B = \mu_0 \mu_r H$
 (C) $B = \mu_0 H^2$ (D) $B = \mu_0 + H$

h. The dielectric strength of a material is

- (A) Current which can pass through it.
 (B) Voltage that can be applied to it.
 (C) Field (voltage per meter thickness) that can be with-stood by it.
 (D) Current density that can be transmitted by it.

i. N -type germanium is obtained on doping intrinsic germanium by

- (A) Phosphorous (B) Aluminium
 (C) Boron (D) Gold

j. Below the ferromagnetic curie temperature, the ferromagnetic material exhibit B-H whose form is

- (A) straight line (B) exponential curve
 (C) B-H loop (D) None of these

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

- Q.2** a. What type(s) of bonding would be expected for each of the following materials: silver, brass (a copper-zinc alloy), rubber, barium sulfide (BaS), solid xenon, bronze, nylon, and aluminium phosphide (AlP)? (8)
- b. Calculate the volume of an FCC unit cell in terms of the atomic radius R . Show that the atomic packing factor for the FCC crystal structure is 0.74. (8)
- Q.3** a. Draw polymer structures for polyethylene, polyvinyl chloride, polypropylene, and polystyrene. (8)
- b. ZnS has the zinc blende structure. If its density is 3.02 g/cm^3 and the lattice parameter is 0.59583 nm , determine the number of Schottky defects per unit cell. (8)
- Q.4** a. State and explain Fick's first and second law of diffusion. (8)
- b. Discuss the properties and uses of copper, aluminium and tungsten as conducting materials. (8)
- Q.5** a. Write the name and describe the three types of polarization. (8)

- b. What is piezoelectricity? What are different applications in which piezoelectricity is used. Describe materials that show piezoelectricity. (2+3+3)
- Q.6** a. There is a net magnetic moment which is associated with each atom in paramagnetic and ferromagnetic materials. Explain why ferromagnetic materials can be permanently magnetized whereas paramagnetic ones cannot. (8)
- b. The magnetic flux density within a bar of some material is 0.630 Tesla at an magnetic field of 5×10^5 A/m. Compute the following for this material: (i) the magnetic permeability, and (ii) the magnetic susceptibility. What type(s) of magnetism would you suggest as being displayed by this material? (8)
- Q.7** a. Some hypothetical metal have an electrical resistivity of 3.3×10^{-8} Ω -m. A specimen of this metal 15 mm thick is passed a current of 25 A; and a magnetic field of 0.95 Tesla is simultaneously imposed in a direction perpendicular to that of the current, a Hall voltage of -2.4×10^{-7} V is measured. Compute (i) the electron mobility for this metal, and (ii) the number of free electrons per cubic meter. (8)
- b. Explain the various steps required in the fabrication of a semiconductor device. (8)
- Q.8** a. Explain in brief dielectric type, ceramic type and electrolytic type of capacitors. (8)
- b. What type of inductors core material would you select for radio frequency inductors? What are the various causes of losses in it? (8)
- Q.9** a. Write short note on production of Czochralski silicon. (6)
- b. The n channel circuit shown in Fig.1 employs one of the several method of self-bias.(i) Assume negligible gate leakage current and show that if $V_{DD} > 0$, then $V_{GSQ} < 0$, and hence the device is properly biased. (ii) If $R_D = 3$ k ohm, $V_{DD} = 15$ V and $V_{DSQ} = 7$ V, find I_{DQ} and V_{GSQ} . (10)

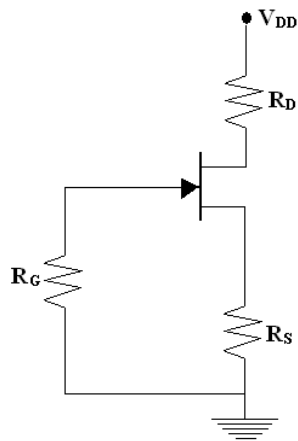


Fig. 1