

B.E DEGREE EXAMINATIONS: JUNE 2010

Second Semester

CIVIL ENGINEERING

PHY102: Materials Science

Time: Three Hours

Maximum Marks: 100

Answer ALL Questions:-

PART A (10 x 1 = 10 Marks)

1. On increasing the impurity concentration in the metal, the residual part of the resistivity
a) decreases b) increases c) remains constant d) may increase (or) decrease
2. A super conducting material when placed in a magnetic field will
a) attract the magnetic field towards its centre
b) attract the magnetic field but transfer it into a concentrated zone
c) repel all the magnetic lines of force passing through it
d) not influence the magnetic field
3. The density of charge carriers in pure semi-conductor is proportional to
a) T b) T^2 c) $T^{3/2}$ d) T^3
4. The Hall field and applied field are
a) same b) different and perpendicular to each other
c) same and perpendicular to each other d) different and parallel to each other
5. Ferrites are sub. group of
a) ferro-magnetic materials b) ferri- magnetic materials
c) diamagnetic materials d) paramagnetic materials
6. In a dielectric, the polarization is
a) linear function of applied field b) square function of applied field
c) Exponential function of applied field d) logarithmic function of applied field
7. Metallic glasses are
a) glasses with metallic impurities b) high strength glasses
c) rapidly quenched metals d) the metals which are in clay form
8. The nanotube shape is
a) spherical b) oval c) cylindrical d) square

9. Thermal resistivity of an insulating material is
- a) Directly proportional to co-efficient of thermal conductivity
 - b) Inversely proportional to square of the thermal conductivity
 - c) Inversely proportional to the thermal conductivity
 - d) Inversely proportional to temperature of insulating material
10. Thermal diffusivity depends
- a) Directly on specific heat of metals
 - b) Directly on square of specific heat of metals
 - c) Inversely on specific heat of metals
 - d) Inversely on time of flow of heat

PART B (10 x 2 = 20 Marks)

11. Define relaxation and collision time of free electron in a metal.
12. What is isotope effect?
13. Why do we prefer extrinsic semi-conductor than intrinsic semi-conductor
14. Distinguish between direct band gap and indirect band gap semi-conductors.
15. What is meant by energy product of a hard magnetic material?
16. In a magnetic material the field strength is found to be 10^6 amp /m. If the magnetic susceptibility of the material is 0.5×10^{-5} , calculate the intensity of magnetization and flux density in the material.
17. What is a ball milling?
18. What are the applications of SMA?
19. What is thermal capacity?
20. Calculate the thickness of the slab of area 90×10^{-4} m² and the thermal conductivity 0.04 w/m/k through which 6 joules of heat is flowing per second through opposite faces maintained at a temperature difference of 20K.

PART C (5 x 14 = 70 Marks)

21. (a) Derive expressions for Electrical conductivity and thermal conductivity and there by obtain Wiedemann Franze law.

(OR)

- (b) (i) Explain Meissner Effect. How is it used to classify the Type I and Type II Super conductors? (7)
- (ii) Write short notes on Cryotron. (4)

The superconducting transition temperature of lead is 7.2K. The initial field at 0K is $64 \times 10^3 \text{ Am/m}$. Calculate critical field at 5K. (3)

22. (a) (i) Obtain the equation for the conductivity of an intrinsic semiconductor in terms of carrier concentration and mobilities. (10)

(ii) Calculate the conductivity of intrinsic semiconductor with carrier concentration of $25 \times 10^{19} / \text{m}^3$, electron mobility $0.38 \text{ m}^2/\text{v-s}$ hole mobility $0.18 \text{ m}^2/\text{v-s}$ at 300K. (4)

(OR)

(b) (i) Give the theory of Hall Effect in the case of a semiconductor. Describe an expression to find the concentration of charge carriers in n-type semiconductors. (12)

(ii) A n-type semiconductor has hall co-efficient $4.16 \times 10^{-4} \text{ m}^3 / \text{c}$. The conductivity is $108 \text{ ohm}^{-1} \text{ m}^{-1}$. Calculate its charge carrier density. (2)

23. (a) (i) What is ferromagnetism? Give an account of the Weiss theory of ferromagnetism and show that the spontaneous magnetization exists below the Curie temperature and it vanishes above Curie temperature. (10)

(ii) A paramagnetic material has a magnetic field intensity of 10^4 A/m . If the susceptibility of the material at room temperature is 3.7×10^{-3} . Calculate the magnetization. (4)

(OR)

(b) (i) What are the properties of dielectric materials? (2)

(ii) Derive an expression for electronic and ionic polarisability in a dielectric material. (10)

(iii) What are the remedies to avoid breakdown mechanism? (2)

24. (a) (i) What are Shape Memory Alloys? Write the characteristics. (7)

(ii) What are metallic glasses? How are they prepared? (7)

(OR)

(b) (i) Explain carbon nano tubes with structure, properties and applications. (9)

(ii) Describe arc method to produce carbon nano tubes. (5)

25. (a) (i) Define co-efficient of thermal conductivity. (2)

(ii) Derive an equation for heat conduction along the bar and solve it for steady state condition. (12)

(OR)

- (b) (i) Derive an expression for radial flow of heat by spherical shell method. (5)
- (ii) Explain the method of determining the thermal conductivity of rubber tube. (5)
- (iii) Calculate heat conducted per hour through glass of thickness 4mm, area 0.9 m^2 and co-efficient of thermal conductivity 1.1 w/m/K if temperature on both sides are 29°C and 3°C respectively. (4)
