KUMARAGURU
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Register Number: ………………..

B.E DEGREE EXAMINATIONS: JUNE 2015

(Regulation 2009)

Second Semester

PHY103: MATERIALS SCIENCE

(Common to AE/MCE/ME)

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. How does the resistance of a metal vary, when its temperature is increased?

a) Increases
b) Decreases
c) Remains the same
d) Becomes half the original value

2. For aluminium the electron density and relaxation time are 18.066 x 10^{28} m^{-3} and 10^{-14} sec respectively. Find the conductivity of aluminium at 25ºC.

a) 50.823 x 10^7 Ωm
b) 508. 23x 10^7 Ωm
c) 5.08 x 10^7 Ωm
d) 2.083 x 10^7 Ωm

3. Select the superconducting material that has the highest transition temperature, among the following.

a) NbTi
b) Nb_3Sn
c) K_3C_{60}
d) $YBa_2Cu_3O_7$

4. Identify the statement which is *incorrect* about semiconductors?

a) A charge carrier may be either a positive hole or an electron
b) Ga- doped Si is a p-type semiconductor
c) n- type and p- type semiconductors are intrinsic semiconductors
d) Doping Si with As introduces a donor level below the conduction band

5. Pick out the type of magnetic material that is used to store digital information in magnetic disks

a) Diamagnetic material
b) Ferromagnetic material
c) Paramagnetic material
d) Antiferromagnetic material

6. Choose the correct relation between the electric vectors **E,D, P** in a dielectric material.

a) $\mathbf{D} = \varepsilon_0 \mathbf{E} + \mathbf{P}$
b) $\mathbf{D} = \varepsilon_0 (\mathbf{E} + \mathbf{P})$
c) $\mathbf{D} = \mathbf{E} + \varepsilon_0 \mathbf{P}$
d) $\mathbf{D} = \frac{1}{\varepsilon_0} \mathbf{E} + \mathbf{P}$

7. Name the high temperature phase of Shape Memory Alloy

a) Martensite
b) Austenite
c) Martaustenite
d) Austmartensite

8. Which of the following statement/s is are true?

i) Volume to surface area ratio is very large for nanomaterials.
ii) The cut-off limit of human eye is 10^{-5} m.
iii) Hardness of a SWNT is about 63×10^{9} Pa.
iv) Carbon nanotubes are cylindrical fullerenes.

a) All four
b) (ii) and (iv)
c) (i), (ii) and (iv)
d) (ii), (iii) and (iv)

9. About imperfections in solids, select the correct statement.

a) Schottky defect does not lead to volume change of the crystal
b) Linear defects include edge and screw dislocations
c) Interfacial defects include grain boundaries, twin boundaries, pores and inclusions
d) The number of point defects in crystal lattices does not depend on temperature

10. Name the property that gets boosted when annealing is done.

a) hardness to the material
b) brittleness to the material
c) softness to the material
d) high conductivity to the material

PART B (10 x 2 = 20 Marks)

11. List the drawbacks of Classical free electron theory.
12. Distinguish between Type – I and Type – II superconductors.
13. How will you convert an intrinsic semiconductor into a p- type semiconductor?
14. Interpret effective mass of an electron.
15. What is meant by hysteresis loop and what do you infer from it?
16. Show that for dielectric materials, the electric susceptibility $\chi_e = \varepsilon_r - 1$
17. What are ferroelectric materials? Give examples.
18. Explain Shape memory effect.
19. What is CNT? Mention any two properties of CNT.
20. Differentiate brittle fracture from ductile fracture.

PART C (5 x 14 = 70 Marks)

21. a) (i) Define density of states. (2)

(ii) Derive an expression for density of states. (12)

(OR)

b) (i) Explain any four properties of superconductors. (8)

(ii) Write short note on Cryotron and Magnetic levitation. (6)

22. a) Obtain the expressions for the concentration of charge carriers in the conduction band and valence band of an intrinsic semiconductor.

(OR)

b) (i) What is Hall effect? Derive the Hall co-efficient for an n-type semiconductor in terms of hall voltage and outline an experimental set up to measure hall voltage. (12)

(ii) An n-type semiconductor has hall coefficient $R_H = -2.16 \times 10^{-4}\ m^3C^{-1}$. The conductivity of the specimen is $100\Omega^{-1}m^{-1}$. Calculate its charge carrier density, n_e and electron mobility, μ at room temperature. (2)

23. a) (i) Discuss the various energies involved in the formation of domains (10)

(ii) What are ferrites? Mention the applications of ferrites. (4)

(OR)

b) (i) What is electronic polarization? Derive an expression for electronic polarizability. (8)

(ii) Explain the frequency and temperature dependence of various polarizations mechanisms in dielectric materials (6)

24. a) (i) Distinguish between ‘ordinary metal’ and ‘ metallic glasses’ (2)

(ii) Explain the preparation, types, properties and applications of metallic glasses. (12)

(OR)

b) (i) Describe the Chemical vapour deposition and Sol-Gel Methods of synthesizing nanomaterials (10)

(ii) Mention four applications of nanomaterials (4)

25. a) Write an essay on crystal defects with special reference to Burger vector.

(OR)

b) Discuss in detail about the various strengthening mechanisms for the improvement of mechanical properties of materials

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