Register Number: ……………………..

B.E DEGREE EXAMINATIONS: DEC 2014

(Regulation 2009)

Second Semester

PHY103: MATERIALS SCIENCE

(Common to AERO/MECH/MCT)

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

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1.   Which of the following is responsible for the drift velocity of electrons?

a) Application of thermal energy   b) Potential of lattice ions in metal

c) Application of external electric field   d) Application of magnetic field

2.   What factor/factors affect the flow of electrons in a material?

a) Thermal vibrations   b) Impurity atoms

c) Crystal defects   d) All

3.   Find the critical current which can pass through a long thin superconducting wire of aluminium of radius 1 mm. Given the critical magnetic field for aluminium is 7.9 x 10^3 A/m

a) 24.81 Amp   b) 49.65 Amp

c) 1500 Amp   d) 1.283 Amp

4.   In a P type material the Fermi level is 0.3 eV above the valence band. If the concentration of accepter atoms is increased, predict the new position of Fermi level.

a) 0.2 eV above the valence band   b) 0.5 eV above the valence band

c) Below the valence band   d) Cannot be predicted

5.   Name the temperature below which certain materials are anti-ferromagnetic and above which they become paramagnetic?

a) Weiss temperature   b) Neel temperature

c) Curie temperature   d)   Double point temperature

6.   Choose the correct temperature dependence of orientation polarization, α_o in a dielectric material

a) $\alpha_o \propto T$ b) $\alpha_o \propto 1/T^2$

c) $\alpha_o \propto 1/T$ d) α_o, does not depend on temperature

7. Of the following condition which one usually does not favour fine grain size of materials?

    a) slow cooling   b) increasing nucleation rate

    c) decreasing growth rate   d) fast cooling

8. Select the right reason/reasons for the unusual properties of nano materials

    a) Small surface area   b) Large surface area

    c) Abnormal atomic number   d) all

9. Which of the following crystal defect is thermodynamically stable?

    a) Volume defect   b) Line defect

    c) Surface defect   d) Point defect

10. Identify the strengthening mechanism applicable to single phase material.

    a) Precipitation hardening   b) Strain hardening

    c) Fiber hardening   d) Dispersion strengthening

PART B (10 x 2 = 20 Marks)

11. Define density of energy states.

12. What type of materials are superconductors? Justify your answer.

13. Interpret effective mass of an electron.

14. The Hall co-efficient of certain silicon specimen was found to be -7.35 x 10^{-5} from 100 to 400 K. What is the nature of the semiconductor? If the conductivity is 200 m^{-1} Ω^{-1}, Calculate the mobility of the charge carrier.

15. Differentiate soft and hard magnetic materials.

16. Define electronic polarization.

17. What are metallic glasses?

18. Outline the sol-gel process.

19. What are Burger Vectors?

20. Define fatigue.

PART C (5 x 14 = 70 Marks)

21. a) (i) State Weidemann Franz law.   (2)

        (ii) Derive expressions for electrical conductivity and thermal conductivity of metals (12) and hence prove Weidemann Franz law.

(OR)

    b) (i) Distinguish between Type –I and Type –II superconductors with examples.   (7)

        (ii) Explain High temperature superconductors and SQUID.   (7)

22. a) (i) Obtain an expression for the concentration of majority carriers in the conduction (10) band of an n-type extrinsic semiconductor.

    (ii) Show in a neat diagram, the nature of variation of Fermi energy level with (4) temperature and impurity concentration in an n-type semiconductor.

(OR)

    b) (i) What is Hall effect? Find the Hall co-efficient for an n-type semiconductor and (10) express it in terms of hall voltage.

    (ii) Demonstrate an experiment for measuring the Hall co-efficient. (4)

23. a) Illustrate the domain theory of ferromagnetism with neat sketches.

(OR)

    b) (i) What is dielectric breakdown? Explain the different types of dielectric (12) breakdown mechanisms.

    (ii) List few remedial features to overcome dielectric breakdown. (2)

24. a) (i) What are shape memory alloys? (2)

    (ii) Explain the characteristics and applications of shape memory alloys. (12)

(OR)

    b) (i) What are carbon nano tubes? (2)

    (ii) Explain the structure and properties of carbon nano tubes. (12)

25. a) Discuss in detail about point defects and line defects in crystals.

(OR)

    b) (i) Explain the Griffith theory of fracture in materials. (9)

    (ii) Distinguish between ductile fracture and brittle fracture. (5)

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