

Mid-West University  
**Examinations Management Office**  
End Semester Examinations-2080

Bachelor level/ B.Sc /6<sup>th</sup> Semester  
Time: 3 hours  
Subject: Solid State Physics (PHY463)

Full Marks: 100  
Pass Marks: 50

*Candidates are required to give their answer in their own words as far as practicable. The figures in the margin indicate full marks.*

Physical constants with their units  
Planck's constant  $h = 6.62 \times 10^{-34} \text{ Js}$ , Speed of light in vacuum  $c = 3 \times 10^8 \text{ m/s}$ , Charge of electron  $e = 1.6 \times 10^{-19} \text{ C}$   
Mass of electron  $= 9.1 \times 10^{-31} \text{ kg}$ ,  $1 \text{ a.m.u.} = 1.67 \times 10^{-27} \text{ kg}$ , Boltzmann constant  $k_B = 1.4 \times 10^{-23} \text{ J/K}$

**Group-A**

[8x2=16]

1) Answer in short any **EIGHT** questions

- a) Describe the structure of NaCl.
- b) Define Current density of electron in metal.
- c) State Wiedemann-Franz law.
- d) Write the short notes on energy band gap of semiconductor at absolute zero temperature.
- e) Explain the ferromagnetic material.
- f) What are the recent applications of superconductors?
- g) Explain the role of electron in conductor?
- h) What is isotope effect?
- i) Difference between elastic and plastic material?
- j) What is metallic bond?

**Group-B**

[6x6=36]

2) Answer in brief any **SIX** questions

- i. What is lattice? Calculate the atomic radii of all the three types of cubic crystals. .
- ii. Define specific heat and derive an expression for the lattice specific heat capacity by Debye model.
- iii. Explain the specific heat of a superconducting material in its normal and superconducting state.
- iv. Derive an expression for density of states and Fermi energy.
- v. Discuss the spontaneous magnetization and domain structure.
- vi. What is Hall voltage? Derive an expression for Hall constant.
- vii. Explain briefly the mechanism of covalent and hydrogen bonding.

**Group-C**

3) Discuss the Langevin's theory of diamagnetism and derive an expression for magnetic susceptibility. [9]

**OR**

Define periodic potential and explain the band structure in solids.

- 4) State and explain the Kronig-Penny model for the band structure of solids. [9]
- 5) Explain the Meissner and isotope effect. [6]
- 6) Define elastic constants. Derive an expression for vibrations of one dimensional diatomic linear lattice. [6]
- 7) Iron crystallizes in bcc structure. Calculate the lattice constant, given that a density of  $7860 \text{ kg/m}^3$  and an atomic weight of  $55.85 \text{ gm}$  respectively. [6]
- 8) The Lead superconductor with  $T_c = 7.2 \text{ K}$  has a critical magnetic field of  $6.5 \times 10^3 \text{ A/m}$  at absolute zero. What would be magnitude of critical magnetic field at  $5 \text{ K}$  temperature? [6]
- 9) The drift velocity of the electron in a copper wire of cross-sectional area  $10 \text{ mm}^2$  when the wire carries a current of  $100 \text{ A}$ . Assume that each copper atom contributes one electron to the electron gas. [6]

**THE END**