



K15P 0091

Reg. No. :

Name :

Third Semester M.A./M.Sc./M.Com. Degree (Reg./Supple./Improve.)
Examination, November 2015
PHYSICS
(2014 Admn.)
PHY 3C11 : Solid State Physics

Time : 3 Hours

Max. Marks : 60

SECTION – A

Answer both questions (Either **a** or **b**).

1. a) Find the dispersion relation for a one-dimensional crystal with two types of atoms and discuss the nature of the optical and acoustic modes.

OR

- b) Discuss the Kronig-Penney model for the motion of electrons in a periodic potential.

2. a) Discuss London equations and obtain an expression for the London penetration depth of magnetic field for a superconductor.

OR

- b) Distinguish between diamagnetism, paramagnetism and ferromagnetism. Discuss the Langevin and quantum theory of diamagnetism. (2×12=24)

SECTION – B

Answer any four (One mark for Part **a**, 3 marks for Part **b**, 5 marks for Part **c**).

3. a) Define Miller Indices.
b) Find the atomic packing factor of a bcc structure.
c) In a crystal, a plane cuts intercepts of $2a$, $3b$, $6c$ along the three crystallographic axes. Determine the Miller indices of the plane.

P.T.O.



4. a) Define Fermi Energy.
- b) Based on Fermi Dirac statistics, state the nature of the Fermi-Dirac distribution function. How does it vary with temperature ?
- c) The density of Zinc is $7.13 \times 10^3 \text{ kg/m}^3$ and its atomic weight is 65.4. Calculate the Fermi energy in zinc. Also calculate the mean energy at 0 K. The effective mass of the electron in zinc is $0.85 m_e$.
5. a) What is Hall effect ?
- b) Show that Hall Coefficient R_H is given by $R_H = 1/Ne$.
- c) Calculate the Hall coefficient of sodium based on free electron model. Sodium has bcc structure and the side of the cube is 4.28 \AA .
6. a) Define effective mass of an electron.
- b) Derive the expression for intrinsic carrier concentration in a semiconductor.
- c) Calculate the intrinsic concentration of charge carriers at 300 K. Given that $m_e^* = 0.12 m_0$, $m_h^* = 0.28 m_0$ and the energy gap for the germanium is 0.67 eV.
7. a) What is Meissner Effect ?
- b) Discuss Type I and Type II superconductors.
- c) The lead material works as superconductor at a temperature of $T_c = 7.26 \text{ K}$. If the constant characteristic field of the lead material at 0 K is $H_0 = 8 \times 10^5 \text{ A/m}$. Calculate the magnetic field in the lead at 5 K.
8. a) What are ferrites ?
- b) What are ferromagnetic domains ? Explain their existence.
- c) A paramagnetic salt contains 10^{28} ions/ m^3 with magnetic moment of one Bohr magneton. Calculate the paramagnetic susceptibility and magnetization produced in a uniform magnetic field of 10^6 A/m , at room temperature.

(4×9=36)