C 31291 (Pages : 2) Name.....

Reg. No.....

THIRD SEMESTER M.Sc. DEGREE EXAMINATION, DECEMBER 2017

(CUCSS)

Physics

PHY 3C 11—SOLID STATE PHYSICS

(2012 Admissions)

Time : Three Hours Maximum : 36 Weightage

Part A

Answer **all** *questions.*

Each question carries 1 *weightage.*

1. Enumerate the Bravais lattices for an orthorhombic system.
2. What is the volume ratio of a conventional unit cell and its Wigner unit cell ?
3. Explain the physical significance of ionic radii.
4. Give the number of optical phonon modes for CaF_2 (3 atoms per unit cell).
5. How is electronic specific heat dependent on temperature ?
6. What is Wiedmann-Franz law ?
7. What is an infinite potential well ?
8. Explain the concept of effective mass.
9. What is Hall effect ?
10. What are ferroelectric domains ?
11. What is Meissner effect ?
12. What is flux quantization ?

(12 × 1 = 12 weightage)

Part B

Answer any **two** *questions.*

Each question carries 6 *weightage.*

1. What are Miller indices ? Draw neat diagrams to indicate Miller indices of the important planes in a simple cubic crystal.
2. Discuss the Einstein model of lattice heat capacity and derive an expression for it.

Turn over

3. Discuss Landau theory of ferroelectric phase transitions.
4. Derive London equations and hence obtain an expression for London penetration depth.

(2 × 6 = 12 weightage)

Part C

Answer any **four** *questions.*
Each question carries 3 *weightage.*

1. Calculate the density of atoms in (1 0 0), (1 1 0) and (1 1 1) planes of BCC Barium whose lattice parameter is 5.02 Å.
2. The Debye temperature of diamond is 1850 K. Calculate the specific heat per Kmol for diamond at 20 K. Also compute the highest lattice frequency involved in the Debye theory.
3. Silver metal has FCC structure and its atomic radius is 1.4 Å. Determine the Fermi energy at 0 K.
4. Show that the wavelength of a moving electron having an energy equal to the Fermi energy at absolute zero is given by $\lambda_F = 2\left(\frac{\pi}{3\pi}\right)^{\frac{1}{3}}$.
5. A magnetic material has a magnetisation of 3200 A/m and flux density of 0.0045 Wb/m^2. Determine the magnetic field and the relative permeability of the material.
6. Calculate the wavelength of the photon required to break a Cooper pair in a superconductor whose critical temperature is 1.2 K.

(4 × 3 = 12 weightage)