



LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION - PHYSICS

THIRD SEMESTER – NOVEMBER 2011

PH 3810/3807 - SOLID STATE PHYSICS - I

Date : 31-10-2011
Time : 9:00 - 12:00

Dept. No.

Max. : 100 Marks

PART – A

Answer **ALL** the questions

(10 X 2 = 20)

1. Sketch (100), (110) planes
2. Distinguish between neutron and X-ray diffractions.
3. What are N and U processes?
4. Distinguish between phonon and photon
5. Explain the concept of degeneracy of electron states.
6. What is Hall effect?
7. Draw the first two Brillouin zones for a square 2D lattice
8. What are the different zone schemes?
9. How does a spherical Fermi surface change in an external electric field?
10. Define electron, hole and open orbits.

PART – B

Answer any **FOUR** questions

(4 X 7.5 = 30)

11. Show that Bragg's equation could be derived from Laue's equations.
12. Gold has the same structure as copper. The velocity of sound in gold is 2100 m/s and that in copper is 3800 m/s. If the Debye temperature of copper is 343 K, determine the Debye temperature of gold. The densities of gold and copper are $1.93 \times 10^4 \text{ kg/m}^3$ and $8.9 \times 10^3 \text{ kg/m}^3$ and their atomic weights are 197 and 63.54 amu respectively.
13. Derive expressions for the Fermi energy and density of states for a free electron gas at 0K.
14. Define effective mass of an electron and discuss its variation with k. Give the physical significance of negative mass.
15. Describe Harrison's construction of Fermi surface in 2D for a divalent metal. Plot it in the extended as well as in the reduced zone schemes.

PART – C

Answer any **FOUR** questions

(4 X 12.5 = 50)

16. Show that reciprocal lattice of (i) SC is SC (ii) FCC is BCC and (iii) BCC is FCC.
17. Derive phonon dispersion relationship for a one dimensional diatomic lattice.
18. Derive an expression for the electronic heat capacity as a function of temperature for a metal. Discuss its behavior at very low temperatures.
19. State and prove Bloch's theorem. Discuss its importance in the band theory.
20. Show that the electron orbits and the flux through the orbits in real space are quantized in a magnetic field.
