LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – PHYSICS

THIRD SEMESTER – APRIL 2010

PH 3810 - SOLID STATE PHYSICS - I

Date & Time: 21/04/2010 / 9:00 - 12:00 Dept. No. Max. : 100 Marks

SECTION – A

Answer **all** the questions. 10 x 2 = 20 Marks

1. Define lattice and basis.
2. The distance between consecutive (111) planes in a cubic crystal is 2Å. Determine the lattice parameter.
3. Mention any two experiments in support of phonons in solids.
4. How do you account for thermal expansion of solids?
5. State two assumptions of free electron theory of metals.
6. The Fermi energy of silver is 5.5eV. Calculate the fraction of free electrons at room temperature located up to a width of kT on either side of E_F.
7. What is the significance of effective mass of an electron?
8. What are the symmetries observed in $E_n(k)$?
9. Define Fermi surface.
10. What is the working principle of dHVA effect?

SECTION – B

Answer any **four** questions. 4 x 7.5 = 30 Marks

11. Write a short note on different types of point defects in solids.
12. Derive an expression for lattice contribution to the thermal conductivity of solids.
13. Derive an expression for Hall coefficient and mention its uses.
14. Explain reduced zone, extended zone and periodic zone schemes of every band structure.
15. Describe Harrison's construction of 2D Fermi surface for mono valent, divalent and trivalent solids.

SECTION – C

Answer any **four** questions. 4 x 12.5 = 50 Marks

16. (a) Obtain the reciprocal lattice vectors for sc, bcc, fcc and hcp lattice.
    (b) Find the Miller indices of a plane that makes an intercept of 3a,2b and c along the three crystallographic axes.
17. (a) Derive an expression for the specific heat of solids on the basis of Debye model.
    (b) Distinguish between normal and umklapp process.
18. Derive an expression to show the effect of temperature on Fermi distribution function.
19. Describe the nearly free electron model. Explain how it is better than the free electron theory.
20. Derive Onsager- Lifshitz quantisation condition to show the effect of magnetic field on Fermi surfaces.

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