

LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034  
M.Sc. DEGREE EXAMINATION – PHYSICS  
THIRD SEMESTER – NOVEMBER 2003  
**PH 3801 / PH 921 – SOLID STATE PHYSICS**

05-11-2003  
1.00 – 4.00

Max. : 100 Marks

**PART – A**

Answer ALL question.

(10 x 2 = 20)

01. Define the reciprocal lattice vector  $\vec{G}$ .
02. What is a Van der Waal's interaction?
03. Outline the principles involved in the inelastic scattering of neutrons by PHONONS.
04. State the implications of observing harmonic lattice vibrations.
05. What is size effect?
06. State Mathiessen rule
07. What is a Fermi sphere?
08. Distinguish between metals and insulators on the basis of energy bands and the number of electrons per primitive cell.
09. State the difference in the paramagnetic behaviour of rare earth and iron group salts.
10. State Curie-Weiss law and its significance.

**PART – B**

Answer any FOUR questions only

(4 x 7.5 = 30)

11. Obtain the dispersion relation for the one dimensional monoatomic lattice and PLOT  $\omega$  vs.  $k$ .
12. Discuss how the nearly FREE electron model for a monoatomic lattice of lattice constant 'a' establishes origin of energy gap.
13. What are the three different zone schemes for studying Fermi surface? Explain.
14. Describe the three phonon collision process and briefly EXPLAIN its role in causing thermal resistivity.
15. What are Magnons? Show that the fractional change of magnetization is proportional to  $T^{3/2}$ .

**PART – C**

Answer any FOUR questions only.

(4 x 12.5 = 50)

16. Obtain the wave equation for an electron in a periodic potential of lattice constant 'a'. Hence give the proof of Bloch theorem.
17. a) Derive a quantitative expression for the electronic heat capacity of a free electron gas at low temperatures. (8.5)
- b) Quantitatively account for the electrical conductivity as a motion of the Fermi sphere. (4)
18. a) Apply quantum theory to obtain Curie's law of para magnetism. (8)
- b) Describe briefly de Haas Van Alphen effect. (4.5)
19. a) Explain Ferromagnetic domains. (5)
- b) Establish theoretically the existence of Bloch Wall between domains in a ferromagnet. (7.5)
20. Write short notes on any TWO of the following
- i) DEBYE'S  $T^3$ -law.
  - ii) Isoentropic cooling by demagnetization
  - iii) Paulis Spin paramagnetism

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