

M.Sc. DEGREE (PGCSS) EXAMINATION

Faculty of Science

First Semester

Applied Physics

APH1C03 – Solid State Physics

[For 2012 admission Students]

Time: Three Hours

Maximum Weight: 30

Part A

(Answer any **SIX** questions. Each question carries a weightage of **ONE**)

1. Define geometrical structure factor and atomic form factor.
2. Distinguish between acoustical and optical phonons.
3. What is Hall Effect?
4. Distinguish between metals, semiconductors and insulators on the basis of band theory.
5. What is antiferromagnetism?
6. Explain the concept of depolarization field.
7. What are the important predictions of BCS theory?
8. Explain London penetration depth.
9. Explain Wiedmann – Franz law.
10. What is an umklapp process?

(6 x 1 = 6 weights)

Part B

(Answer any **FOUR** questions. Each question carries a weightage of **TWO**)

11. Show that the reciprocal lattice of a body centered lattice is a face centered lattice.
12. X-ray of wavelength 1.1 \AA is found to be Bragg reflected from the (100) and (110) planes of a simple cubic structure. If the lattice parameter of the crystal is 3 \AA , find the angles for first order diffraction from these planes.
13. Based on the concept of free electron gas, show that the electrical conductivity of a metal is $Ne^2\tau/m$.
14. A superconducting sample has a critical temperature of 4.1 K in zero magnetic field and critical field of 0.0505 T at 0 K. Find the critical field at 2 K.
15. For a dielectric, prove that $\frac{\epsilon_r - 1}{\epsilon_r + 2} = \frac{P}{3\epsilon_0} \sum_i N_i \alpha_i$.
16. The magnetic field in silicon is $1.2 \times 10^5 \text{ Am}^{-1}$. Calculate the magnetization and flux density in silicon, if its magnetic susceptibility is -4.2×10^{-6} . Also calculate the value of relative permeability of the material.

(4 x 2 = 8 weights)

Part C

(Answer any **ALL** questions. Each question carries a weightage of **FOUR**)

17. (a) Explain the Ewald construction. Discuss reciprocal lattice concept is useful in X-ray diffraction studies.

OR

(b) Obtain an expression of specific heat capacity of a solid using Debye model.

18. (a) Discuss the Kronig – Penny model for the motion of an electron in a periodic potential

OR

(b) What is meant by free electron Fermi gas? Derive an expression for heat capacity of metals based on this concept.

19. (a) Explain the difference between diamagnetism and paramagnetism. Briefly explain the quantum theory of paramagnetism

OR

(b) Discuss Landau theory of ferroelectric phase transitions

20. (a) Give an account of superconductivity. Explain type I and type II superconductors. Write a note Meissner effect.

OR

(b) What are d.c. and a.c. Josephson effect? Give the theory of a. c. Josephson effect

(4 x 4 = 16 weights)