

B. Sc. DEGREE END SEMESTER EXAMINATION - MARCH 2026**SEMESTER 6 : PHYSICS****COURSE : 19U6CRPHY12 : SOLID STATE PHYSICS***(For Regular 2023 Admission and Supplementary 2022/ 2021 /2020/2019 Admissions)*

Time : Three Hours

Max. Marks: 60

PART A**Answer any 8 (2 marks each)**

1. Show the variation of Fermi-Dirac distribution function versus energy at absolute temperature and at two temperatures above it.
2. Why is dipolar polarisability sensitive to temperature? Give a possible explanation.
3. Write down the expression for electrical conductivity of an intrinsic semiconductor. Explain the terms.
4. What is the origin of ferromagnetism?
5. Write down the properties of reciprocal lattice vectors?
6. Describe mobility and conductivity of an intrinsic semiconductor.
7. Explain the variation of susceptibility with temperature for antiferromagnetic materials.
8. Draw (111) plane.
9. Name different crystal systems.
10. Why the electronic specific heat capacity of a free electron gas deviates from the classical expression?

(2 x 8 = 16)**PART B****Answer any 6 (4 marks each)**

11. Prove that reciprocal lattice to a body centered lattice is face centered lattice.
12. Write down the Schrodinger equation for a free electron gas in three dimensions. Obtain the eigen functions and the eigen values.
13. Lead in the superconducting state has critical temperature of 6.2 K at zero magnetic field and a critical field of 0.064 MA m^{-1} at 0 K. Determine the critical field at 4 K.
14. Determine the Miller indices of a plane, which is parallel to X-axis and makes intercepts of 2 and $\frac{1}{2}$ respectively along Y and Z axes?
15. A magnetic material has a magnetization of 3300 ampere/metre and flux density 0.0044 weber/metre². Determine the magnetizing field intensity and relative permeability.
16. The resistivity of intrinsic silicon at room temperature is $3000 \Omega\text{m}$. Calculate the intrinsic carrier density. Given electron mobility = $0.14 \text{ m}^2/\text{V-s}$ and hole mobility = $0.05 \text{ m}^2/\text{V-s}$
17. A rod of magnetic material, 0.5 m in length has a coil of 200 turns wound over uniformly. If a current of 2 A is sent through it, calculate (i) the magnetizing field H (ii) intensity of magnetization M (iii) magnetic induction B (iv) relative permeability of the material.
Given $\mu_0 = 6 \times 10^{-3}$
18. Briefly discuss the Bloch theorem.

(4 x 6 = 24)

PART C

Answer any 2 (10 marks each)

19. Write a note on the origin of (a) Covalent bonding (b) Metallic bonding (c) hydrogen bonding and (d) Van der Waals bonding.
20. (a) Derive an expression for the interplanar distance for a simple cubic structure crystal. (b) Also find the inter-planar spacing between the planes (101) of a cubic crystal, if lattice constant is 2.6 \AA ?
21. What are superconductors? Explain the Josephson junction effect and SQUID. Describe applications of SQUID.
22. Derive an expression for the binding energy of an ionic crystal. Obtain an expression for the Madelung constant. Evaluate the Madelung constant for a linear ionic crystal.

(10 x 2 = 20)