D 132060 **(Pages : 2)** **Name.....**

Reg. No.....

THIRD SEMESTER M.Sc. DEGREE [REGULAR/SUPPLEMENTARY] EXAMINATION, NOVEMBER 2025

(CBCSS)

Physics

PHY 3C 11—SOLID STATE PHYSICS

(2019 Admission onwards)

Time : Three Hours Maximum : 30 Weightage

Section A

Answer **all** *questions, each carries weightage* 1.

1. Distinguish between para and ferromagnetism.
2. Explain the indirect band gap semiconductors.
3. What are Miller indices ?
4. What do you mean by perfect diamagnetism in superconductors ?
5. Give example of material exhibiting SC and BCC structure.
6. Explain the Wiedemann-Franz law.
7. What are the importances of hall co-efficient in material analysis ?
8. What are piezoelectric materials ? Give applications of it.

(8 × 1 = 8 weightage)

Section B

Answer any **two** *questions, each carries weightage* 5.

9. Prove that the motion of electrons through the periodic potential in solids give rise to band structure.
10. Describe the Einstein model of lattice heat capacity. Discuss the success and failure of this model at different temperatures.

Turn over

11. Derive an expression for diamagnetic susceptibility using the quantum theory. Explain the temperature dependence of susceptibility.

12. Give an account of the phenomenon of superconductivity. Distinguish between type I and type II superconductors. List out few applications of superconductors.

(2 × 5 = 10 weightage)

Section C

Answer any **four** *questions, each carries weightage* 3.

13. Derive the relationship between dielectric constant and atomic polarizability.

14. N-type Ge sample has donor concentration $10^{21}/m^3$ and thickness = 3 mm. is used in a Hall Effect experiment set up. Find the Hall voltage, if B = 0.5 T and J = 500 A/m^2. Also find the hall co-efficient.

15. The energy near the valence band edge of a crystal is given by $E = -Ak^2$, where $A = 10^{-39}$ Jm^2. An electron with wave vector $k = 10^{10}\ k_x\ m^{-1}$ is removed from an orbital in the completely filled valence band. Determine the effective mass, velocity and momentum of the hole.

16. The lead material works as superconductor at a temperature of T_c = 7.26 K. If the constant characteristic field of the lead material at 0 K is $H_0 = 8 \times 10^5$ A/m. Calculate the magnetic field in the lead at 5 K.

17. A ferromagnetic material with J = 3/2 and g = 2 has a Curie temperature of 125 K. Calculate the intrinsic flux density near 0 K. Also, calculate the ratio of the magnetization at 300 K in the presence of an external field of 1 mT to the spontaneous magnetization at 0 K.

18. Two dimensional lattice has the basis vectors :

    $a = 2\hat{x}$, $b = \hat{x} + 2\hat{y}$. Find the reciprocal lattice vectors.

19. The Debye temperature of diamond is 2000 K. Calculate the mean velocity of sound in diamond, given the density and atomic mass of diamond as 3500 kgm^{-3} and 12 amu respectively.

(4 × 3 = 12 weightage)