D 150365 **(Pages : 2)** **Name.....**

Reg. No.....

THIRD SEMESTER M.Sc. (CBCSS) REGULAR/SUPPLEMENTARY DEGREE EXAMINATION, NOVEMBER 2026

Physics

PHY 3C 11—SOLID STATE PHYSICS

(2019 Admission onwards)

Time : Three Hours Maximum Weightage : 30

Section A

8 *Short questions answerable within* 7.5 *minutes.*
Answer **all** *questions.*
Each question carries 1 *weightage.*

1. What are Bravais lattices ?
2. Define the term *cohesive energy*.
3. What is the Debye temperature ?
4. Explain the origin of Hall voltage.
5. What are Bloch functions ?
6. Define piezoelectricity with an example.
7. What is the Weiss molecular field ?
8. Distinguish between Type I and Type II superconductors.

(8 × 1 = 8 weightage)

Section B

4 *Essay questions answerable within* 30 *minutes.*
Answer any **two** *questions.*
Each question carries 5 *weightage.*

9. (a) Explain the NaCl crystal structure.
   (b) Derive the expression for the Madelung constant of an ionic crystal (qualitative derivation is sufficient).
10. (a) Describe the quantization of lattice vibrations.
    (b) Explain inelastic scattering of neutrons and photon creation and annihilation.
11. Discuss the Kronig-Penney model with necessary theory and explain how energy bands are formed in solids.

Turn over

12. (a) Explain Langevin's theory of paramagnetism.

    (b) Describe Neel's model of antiferromagnetism.

(2 × 5 = 10 weightage)

Section C

7 Problems answerable within 15 minutes.
Answer any **four** *questions.*
Each question carries 3 weightage.

13. Calculate the density of diamond given : Lattice constant a = 3.57 Å, Atoms per unit cell = 8, Atomic mass of carbon = 12 g mol.$^{-1}$

14. A linear monoatomic chain has lattice spacing a = 2 Å and force constant C = 40 Nm.$^{-1}$

    Calculate the photon angular frequency at $k = \frac{\pi}{2a}$.

15. For a metal with Fermi energy E_F = 7 eV, compute :

    (a) Fermi velocity.

    (b) Fermi temperature.

16. Calculate the electrical conductivity of a semiconductor using :

$$n = 3.5 \times 10^{21} \text{m.}^3,\ \mu_e = 0.14\ \text{m}^2\text{V}^{-1}s^{-1},\ \mu_h = 0.05\ \text{m}^2\text{V}^{-1}s^{-1}.$$

17. A dielctric has relative permittivity ε_r = 4.5. Given $\varepsilon_o = 8.85 \times 10^{-12}$ F m^{-1} and electric field

$$E = 2 \times 10^5 \text{ V m}^{-1},$$

    calculate the polarization.

18. A ferromagnet has saturation magnetization

$$M_s = 1.2 \times 10^6 \text{ A m}^{-1}.$$

    If the Weiss molecular field constant is

$$\lambda = 7 \times 10^{-4},$$

    calculate the Weiss field.

19. A Josephson junction has critical current I_c= 3 mA and resistance R = 2Ω. Find the AC Josephson oscillation frequency when biased at V = 2 mV.

(4 × 3 = 12 weightage)