D 111208 (**Pages : 2**) **Name**.....

Reg. No.....

THIRD SEMESTER M.Sc. (CBCSS) [REGULAR / SUPPLEMENTARY] EXAMINATION, NOVEMBER 2024

Physics

PHY 3C 11—SOLID STATE PHYSICS

(2019 Admission onwards)

Time : Three Hours Maximum : 30 Weightage

Section A

Answer **all** *questions.*

Each question carries 1 *weightage.*

1. Discuss the Weiss theory of ferromagnetism.
2. What are symmetry operations ? Name the symmetry elements of a crystal.
3. What are the importance of Miller indices ?
4. Give example of material exhibiting FCC and HCP structure.
5. Briefly explain Hall Effect.
6. Distinguish between type I and type II superconductors.
7. What do you meant by direct band gap semiconductors ?
8. Discuss the ferroelectric and paraelectric states.

(8 × 1 = 8 weightage)

Section B

Answer any **two** *questions.*

Each question carries 5 *weightage.*

9. Discuss the formation of allowed and forbidden energy bands on the basis of the Kronig Penny model.
10. Derive expression for electron and hole concentration for an intrinsic semiconductors. Use these results to obtain intrinsic carrier concentration.

Turn over

11. Discuss the Debye model of lattice heat capacity. Give drawbacks of the Debye model.

12. Describe the Langevin's theory of paramagnetism and obtain an expression for paramagnetic susceptibility. Mention the temperature dependence of susceptibility.

(2 × 5 = 10 weightage)

Section C (Essay Questions)

Answer any **four** *questions.*

Each question carries 3 *weightage.*

13. The energy E(k) of electrons of wave vector k in a solid is given by $E(k) = Ak^2 + Bk^4$, where A and B are constants. Find the effective mass of electrons at $[k] = k_0$?

14. Find out reciprocal lattice vectors for a space lattice defined by the following primitive translation vectors :

$a = 5\hat{i} + 5\hat{j} - 5\hat{k}$, $b = -5\hat{i} + 5\hat{j} + 5\hat{k}$, $c = 5\hat{i} - 5\hat{j} + 5\hat{k}$.

15. The critical fields at 6 K and 8 K for a NbTi alloy are 7.616×10^6 and 4.284×10^6 A/m respectively. Determine the transition temperature and the critical field at 0 K.

16. The mobility of hole is $\mu_h = 0.025$ m^2/Vsec. What would be the resistivity of p-type silicon if the hall coefficient of the sample is 2.25×10^{-5} m^3/C ?

17. Dy^{3+} has outer electronic configuration of $4f^9 6s^0$. Calculate the magnetic susceptibility for a salt containing one kg mole of Dy^{3+} ions at 300 K.

18. The unit cell volume of sodium is 7.93×10^{-29} m^3. Calculate the Fermi energy of sodium at absolute zero.

19. Derive the Clausius-Mossotti relation by considering the local field effects.

(4 × 3 = 12 weightage)