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D 51330 (Pages : 2) Name.....

Reg. No.....

THIRD SEMESTER M.Sc. DEGREE (REGULAR/SUPPLEMENTARY) EXAMINATION, NOVEMBER 2023

(CBCSS)

Physics

PHY 3C 11—SOLID STATE PHYSICS

(2019 Admission onwards)

Time : Three Hours Maximum : 30 Weightage

Section A

Answer **all** *questions.*
Each question carries weightage 1.

1. Distinguish between para and ferromagnetism.
2. What are symmetry operations ? Name the symmetry elements of a crystal.
3. What are Miller indices ?
4. Give example of material exhibiting SC and BCC structure.
5. Briefly explain Hall effect.
6. Distinguish between Type I and Type II superconductors.
7. What do you meant by indirect band gap semiconductors ?
8. Discuss the ferroelectric and paraelectric states.

(8 × 1 = 8 weightage)

Section B

Answer any **two** *questions.*
Each question carries weightage 5.

9. Give an account of the phenomenon of superconductivity. Distinguish between Type I and Type II superconductors. List out few applications of superconductors.
10. Discuss the formation of allowed and forbidden energy bands on the basis of the Kronig Penny model.

Turn over

11. Describe the Einstein model of lattice heat capacity. Discuss the success and failure of this model at different temperatures.

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

Answer any **four** *questions.*
Each question carries weightage 3.

13. 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.

14. 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.

15. Two dimensional lattice has the basis vectors

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

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 co-efficient of the sample is $2.25 \times 10^{-5}\ m^3/C$?

17. 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.

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

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

(4 × 3 = 12 weightage)