D3APH1903 **(2 Pages)** **Name.....**
Reg.No.....

THIRD SEMESTER M. Sc. DEGREE EXAMINATION, NOVEMBER 2020
PHYSICS
FPHY3C11- SOLID STATE PHYSICS

Time: Three Hours **Maximum Weightage: 30**

Part A: Short answer questions. Answer *all* questions. Each carries *one* weightage.

1. What are Brillouin zones? Construct first Brillouin zones for a two dimensional square lattice.
2. Plot the dispersion curve for lattice vibration of a crystal with two atoms per primitive cell.
3. Explain Wiedemann-Franz law.
4. Explain the concept of effective mass.
5. Distinguish between direct and indirect bandgap semi conductors. Give examples.
6. State Hund's rule to obtain the ground state of an atom.
7. Explain Neel's model of anti-ferromagnetism.
8. Distinguish between pyro electric and piezo electric materials.

(8 × 1 = 8 weightage)

Part B: Essay questions. Answer any *two* questions. Each carries *five* weightage.

9. What are reciprocal lattices? Show that reciprocal lattice to BCC lattice is an FCC lattice and reciprocal lattice to FCC lattice is BCC.
10. Derive Curie-Weiss law for ferromagnetism.
11. Derive the London equations and explain how its solution accounts Meissner effect.
12. Discuss Einstein's model of lattice heat capacity and derive an expression for it. How does the Debye model different from it?

(2 × 5 = 10 weightage)

(P.T.O.)

Part C: Problems. Answer any *four* questions. Each carries *three* weightage.

13. Determine the Miller indices of a plane that makes intercepts of $2A^o$, $3A^o$ and $4A^o$ on the coordinate axes of an orthorhombic crystal with a : b : c = 4 : 3 : 2.

14. Show that the average kinetic energy per electron for a three dimensional free electron gas at 0K is 3/5 E_F, where E_F is the Fermi energy.

15. Discuss the Landau theory of ferroelectric phase transition.

16. Prove that the Fermi level in an intrinsic semi conductor lies in the middle of the forbidden gap, if the effective mass of electrons and holes are equal.

17. A paramagnetic salt contains 10^{28} ions/m^3 with magnetic moment of one Bohr magneton. Calculate the paramagnetic susceptibility and the magnetization produced in a uniform magnetic field of 10^6 A/m at room temperature.

18. A superconducting material has a transition temperature of 3.7 K at zero magnetic field and a critical field of $3x10^5$A/m at 0 K. Find the critical field at 2 K.

19. Sodium metal with a BCC structure has two atoms per unit cell. The radius of the sodium atom is 1.85 A^o. Calculate its electrical resistivity at 0^oC if the classical value of the mean free time at this temperature is $3x10^{-14}$ s.

(4 × 3 = 12 weightage)