THIRD SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2021
(CBCSS-PG)
(Regular/Supplementary/Improvement)
CC19P PHY3 C11 - SOLID STATE PHYSICS
(Physics)
(2019 Admission onwards)

Time: Three Hours   Maximum: 30 Weightage

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

1. Write a short note on HCP Structure. Give examples.

2. Derive the expression for Einstein model of heat capacity of a material.

3. Describe the expression for Fermi Energy and Fermi Velocity using Sommerfeld theory.

4. Write a short note on Hall Effect.

5. Explain different properties of holes.

6. Explain Meissner Effect.

7. Briefly explain Polarization Catastrophe.

8. Write a short note on order disorder type of ferroelectric with an example.

(8 × 1 = 8 Weightage)

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

9. What is Bloch function? Discuss the formation of allowed forbidden energy bands on the basis of Kronig-Penney Model.

10. Discuss the vibrational modes of a lattice with two atoms per primitive cell.

11. Derive the expression for heat capacity of electron gas.

12. What is Josephson effect. Discuss DC Josephson effect and AC Josephson effect.

(2 × 5 = 10 Weightage)

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

13. The KCl crystal is in the form of simple cubic crystal structure. Determine interatomic spacing 'd' and the glancing angle at which X-ray of wavelength 1.787 A° is reflected in the third order. The density of KCl is 1990 kg/m^3. Molecular weight is 74.6 amu.

14. The Debye temperature of carbon(diamond) is 1850 K. Calculate the sp. Heat per kilo mol for diamond at 20 K. Also compute highest lattice frequency involved in the Debye Theory.

15. A copper wire of cross section 5×10^{-2} cm^2 carries a steady current of 50 amperes. Assume on free electron per atom, calculate density of free electrons, average drift velocity and relaxation time. Given resistivity of copper is 1.7×10^{-8} Ωm.

16. Fermi Energy of copper id 7 eV. Calculate (i) Fermi Momentum of electron in copper. (ii) The De-Broglie wave length of electrons. And (iii) Fermi Velocity.

17. The intrinsic carrier concentration of Germanium sample is 2.4×10^{19} /m^3 at 300 K. Its electron and hole mobilities are 0.39 and 0.19 m^2/V/s respectively, calculate the conductivity of sample.

18. Calculate the induced dipole moment per unit volume (polarization density) of He gas when it is placed in a field of 6×10^5 V/m. The atomic polarizability of He is 0.18×10^{-40} Fm^3 and concentration of He atom is 2.6×10^{25} m^3. Also calculate separation of positive and negative charges in atom.

19. The penetration depth of lead are 396 A° and 1730 A° at 3 K and 7.1 k respectively. Calculate the critical temperature of lead.

(4 × 3 = 12 Weightage)

****