21P308 (Pages: 2) Name: .....

Reg.No: .....

THIRD SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2022

(CBCSS - PG)

(Regular/Supplementary/Improvement)

CC19P PHY3 C11 - SOLID STATE PHYSICS

(Physics)

(2019 Admission onwards)

Time : 3 Hours Maximum : 30 Weightage

Section A

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

1. Explain the concept of brillouin zone.
2. Explain the difference between Einstein and Debye Model of specific heats.
3. What are the drawbacks of classical free electron theory?
4. State and prove Bloch theorem
5. Briefly explain the frequency dependance of total polarisability.
6. Write a short note on ferroelectric crystals and ferroelectric domains.
7. Briefly explain the exchange interaction leading to ferromagnetism in materials.
8. Write a short note on superconductivity.

(8 × 1 = 8 Weightage)

Section B

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

9. What is meant by Madelung interaction? Discuss the nature of cohesion and obtain expression of cohesive energy in ionic crystals
10. Discuss the vibrational modes of a lattice with two atoms per primitive cell.
11. What is Bloch function? Discuss the formation of allowed forbidden energy bands on the basis of Kronig-Penney Model.
12. Give an account of a.c Josephson effect with relevant theory.

(2 × 5 = 10 Weightage)

Section C

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

13. Lead has atomic density 11.35 gm/cm^3 and atomic mass 205 amu. Calculate the number of atoms per m^3 in lead.

14. Show that the reciprocal lattice for a bcc lattice is a fcc structure and vice versa.

15. The intrinsic carrier density is 1.5 x 10^{16} m^{-3}. If the mobility of electron and hole are 0.13 and 0.05 m^2 V^{-1} s^{-1}, calculate the conductivity.

16. A Ge sample is doped with 5 x 10^{13} Arsenic atoms per cm^3. Determine the carrier concentration of 300 K. Intrinsic concentration of Ge at 300 K is 2.5 x 10^{13} cm^{-3}.

17. A solid contains 5x10^{28} atoms/m^3 each with a polarisability of 2x10^{-40} Fm^2. Assuming that the internal field is given by Lorentz formula, calculate the ratio of internal field to the external field.

18. Calculate the value of magnetic susceptibility for a paramagnetic material *($N=9x10^{28}$ m^{-3}) at 0.1 K.*

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)

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