17P312   (Pages: 2)   Name……………………..

Reg. No…………………..

THIRD SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2018

(Regular/Supplementary/Improvement)

(CUCSS - PG)

CC15P PHY3 C11 / CC17P PHY3 C11 - SOLID STATE PHYSICS

(Physics)

(2015 Admission onwards)

Time : Three Hours   Maximum : 36 Weightage

PART A

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

1. What is a phonon? Explain the term phonon momentum.

2. Briefly explain the Landau theory of ferro-electric phase transition.

3. Write a short note on ferrimagnetism.

4. State the main differences between Einstein's and Debye's models of specific heat in crystals.

5. Describe Hall Effect.

6. Discuss how imperfection affect thermal conductivity of a specimen.

7. Explain the First Brillouin Zone for a two dimensional reciprocal lattice is constructed.

8. Briefly explain the optical phonon branch and acoustical phonon branch.

9. Give the crystal structure of 'diamond'.

10. List two important properties of superconductors.

11. Give qualitative description of BCS theory.

12. Explain adiabatic demagnetization in paramagnetic salts.

(12 x 1 = 12 Weightage)

PART B

Answer any *two* questions. Each question carries 6 weightage.

13. What is meant by Medelung interaction? Discuss the nature of cohesion and obtain expression of cohesive energy in ionic crystals.

14. Explain the failures of "free electron theory". Describe with necessary theory the Kronig-Penny model and show how the formation of bands is explained in this theory.

15. Describe the difference between Type I and Type II superconductors. Derive London equations for superconductors and hence the phenomenon of penetration of magnetic field into superconductors.

16. What is meant by Polarization mechanism in dielectrics? Discuss the different polarization mechanisms in dielectrics and explain their temperature dependence.

(2 x 6 = 12 Weightage)

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

17. What is London penetration depth? The London penetration depth of Pb at 3 K and 7.21 K are 39.6 nm and 173 nm respectively. Calculate its

(a) transition temperature and (b) penetration depth at 0 K.

18. Diamond (Atomic No. of Carbon = 12) has Young's modulus $10^{12} Nm^2$ and density of 3500 kg/m^3. Ignoring the crystalline anisotropy and difference between longitudinal shearing module, calculate Debye temperature.

19. Dielectric constant of Helium measured at 0ºC at one atmosphere is 1.0000684: under these conditions the gas contains 2.7×10^{25} atoms/m^3. Calculate the radius of the electron cloud (atomic radius) and the displacement when Helium atom is subjected to an electric field of 10^6V/m.

20. The density of Zinc is 7.13×10^3 kg/m^3 and its atomic weight is 65.4 Calculate the free energy in Zinc. Also calculate the mean energy at 0 K. The effective mass of electron is 0.85 m_e.

21. The density of Silver is 10.5 gm/cc and its atomic weight is 107.9. Assuming that each Silver atom provides on conduction electron, calculate the number of free electrons per cc. Taking conductivity of Silver as 6.8 $\times 10^7$ mhos/m. Calculate the mobility of free electrons.

22. Lattice constant of unit cell of "alpha iron" is 0.287 nm. Find the number of atoms per mm^2 of planes (100), (110), and (111), if structure of "alpha iron" is 'BCC'.

(4 x 3 = 12 Weightage)

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