15P307 (Pages:2) Name……..

Reg. No……..

THIRD SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2016

(CUCSS - PG)

(Physics)

CC15P PHY3 C11 - SOLID STATE PHYSICS

(2015 Admission)

Time : Three Hours Maximum : 36 Weightage

Section-A

(Answer ***all*** Questions. Each question carries weightage one)

1. Show that the Madelung constant for one dimensional array of ions of alternating sign with a distance 'a' between successive ions is given by 2 ln2.
2. Derive Laue equation
3. Explain briefly the inelastic scattering of neutrons by a crystal lattice
4. Give a qualitative derivation of electronic heat capacity
5. State and prove Bloch theorem
6. Explain the concept of hole
7. Explain Wiedemann- Franz law
8. Explain polarization catastrophe
9. Explain Hund rules
10. Describe the appearance of parallel and perpendicular magnetic susceptibility in antiferromagnetic materials.
11. Explain the concept of flux quantization in a superconducting ring
12. Explain the concept of BCS ground state

(12×1=12 Weightage)

Section-B

(Answer *any* ***two*** questions Each question carries weightage 6)

13. Derive Einstein and Debye model of lattice specific heat. How do these models agree with experimental results?
14. Discuss Weiss theory of ferromagnetism. Explain hysteresis curve and transition between domains
15. Describe the Kronig- Penny model with necessary theory.
16. Explain DC and AC Josephson Effect **(2×6=12Weightage)**

Section – C

(Answer *any* ***four*** Questions. Each Question carries weightage three)

17. For a specimen of a superconductor, the critical fields are respectively 1.4×10^5 and 4.2×10^5 A/m for 14 K and 13 K. Calculate the transition temperature and critical fields at 0 K and 4.2 K.

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

19. In an intrinsic semiconductor the effective mass of the electron is 0.07 m_e and that of the hole is 0.4 m_e, where m_e is the rest mass of the electron equaling 9.1×10^{-31} Kg. Calculate the intrinsic concentration of charge carriers at 300K. Given: $E_g = 0.7$ eV.

20. A typical magnetic field achievable with an electromagnet with iron core is about 1 tesla. Compare the magnetic interaction energy $\mu_B B$ of an electron spin magnetic dipole moment with $K_B T$ at room temperature and show that at ordinary temperature the approximation $K_B T / \mu_B B >> 1$ is valid.

21. Zinc has hcp structure. The height of the unit cell is 0.494 nm. The nearest neighbor distance is 0.27 nm. The atomic weight of Zn is 65.37. Calculate the volume of the unit cell and density of Zn.

22. Show that $D(E) = 3N/2E$, where N is the total no of orbitals in a free electron gas with energy E.

(4×3= 12Weightage)

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