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Reg. No. : .....

Name : .....

Sixth Semester B.Sc. Degree Examination, March 2021

First Degree Programme Under CBCSS

Physics

Core Course IX

PY 1641 – SOLID STATE PHYSICS

(2018 Admission Regular)

Time : 3 Hours Max. Marks : 80

SECTION – A

(Answer **all** questions in one or two sentences; each question carries **1** mark).

1. What is a unit cell?
2. Define crystallographic axis.
3. What is forbidden energy gap?
4. What is the meaning of heat capacity?
5. What is Hall effect?
6. What is an extrinsic semiconductor?
7. What is magnetic susceptibility?
8. What is electric susceptibility?

P.T.O.

9. What is the critical temperature of a superconductor?

10. How are Cooper pairs formed?

(10 × 1 = 10 Marks)

SECTION – B

(Answer **any eight** questions, not exceeding a paragraph; each question carries **2** marks).

11. Distinguish between crystalline and amorphous solid.

12. Write a note on different types of bonding.

13. State and explain Bragg's law of x ray diffraction.

14. Write down the applications of x- ray diffraction techniques.

15. What is the difference between Conductors, Semiconductors and Insulators?

16. What is the basic assumption of Kronig Penney model? What are the use and conclusions of this model?

17. Obtain an expression for conductivity of an intrinsic semiconductor.

18. What is meant by band gap? How does it work?

19. What is difference between n type and p type semiconductor explain with the help of energy band diagram?

20. What is hysteresis loss?

21. What is Curie-Weiss law? Discuss its limitations.

22. Explain Weiss theory of ferromagnetism.

23. Explain plasma oscillations.

24. Distinguish between type-I and type-II superconductors.

25. Describe isotope effect in superconductors.

26. Give the salient features of BCS theory.

(8 × 2 = 16 Marks)

SECTION – C

(Answer **any six**, each question carries **4** marks).

27. How many atoms are there in primitive cell of diamond? What is the length of primitive translation vector if the cube edge a = 3.56A°.

28. Write down the miller indices for planes in 3*a*, 3*b*, 2*c* intercepts.

29. Lead in the superconducting state has critical temperature of 2.6K at zero magnetic field and a critical field of 0.624 tesla at 0K. Determine the critical field at 4K.

30. The spacing between the principle planes of NaCl crystal is 2.82A°. It is found that first order Bragg reflection occurs at an angle of 100. What is the wavelength of x rays.

31. Find the total polarizabilty of CO_2, if its susceptibility is 0.985×10^{-3}. Density of CO_2 is 1.977kg/m^3 and its molecular weight is 44.

32. The atomic radius of sodium is 1.86A°. Calculate the Fermi energy of sodium at absolute zero.

33. Estimate the order of the diamagnetic susceptibility of copper by assuming that only one electron per atom makes the contribution. The radius of the copper atom is 1A° and the lattice parameter is 3.608A°.

34. Approximately how large must be the magnetic induction for the orientation energy to be comparable to the thermal energy at room temperature. Assume $\mu_m = 5\mu_B$.

35. Find the Hall coefficient and electron mobility for germanium sample (length 1cm, breadth 5 mm and thickness 1mm), a current of 5t milliamperes flown from a 1.35 volts supply develops a Hall voltage of 20 millivolts across the specimen in a magnetic field of 0.45 Webbers/m^2.

36. In intrinsic GaAs, the electron and hole mobilities are 0.85 and 0.04 m^2/V-s respectively and the corresponding effective masses are 0.068 m_o and 0.5 m_o respectively where m_o is the rest mass of the electron. Given the energy band gap at 300K as 1.43e*V*. Determine the intrinsic carrier concentration.

37. For a specimen of V_3Ga, the critical fields are respectively 1.4×10^5 and 4.2×10^5 Am^{-1} for 14K and 13K. Calculate the transition temperature.

38. How do normal and anomalous dispersion differ?

(6 × 4 = 24 Marks)

SECTION – D

(Answer **any two** questions; each question carries **15** marks).

39. What are Miller indices? How the orientation of a plane is specified by Miller indices? Explain their importance?

40. Derive expressions for the Fermi energy and density of states for a free electron gas in one dimension.

41. State and prove Bloch theorem. Discuss its importance in the band theory.

42. Derive the Clausius-Mosotti relation representing the relationship between dielectric constant and atomic polarizabilty.

43. Derive an expression for Langevin's theory of paramagnetism and obtain an expression paramagnetic susceptibility. Discuss the temperature dependence of susceptibility.

44. What is superconductivity? Explain Meissner effect. What are the applications of superconductors?

(2 × 15 = 30 Marks)
