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Sixth Semester B.Sc. Degree Examination, April 2022

First Degree Programme under CBCSS

Physics

Core Course IX

PY 1641- SOLID STATE PHYSICS

(2018 & 2019 Admission)

Time : 3 Hours Max. Marks : 80

SECTION – A

Answer **all** questions; each carries **1** mark.

1. What is a unit cell?
2. Name four symmetry operations.
3. What is free electron gas?
4. What is the Hall effect?
5. What is Bloch theorem?
6. What is an intrinsic semiconductor?
7. Define polarization.

P.T.O.

8. Define magnetization.

9. What is Paramagnetism?

10. What is Meissner effect?

(10 × 1 = 10 Marks)

SECTION – B

Answer any **eight;** each carries **2** marks.

11. What are Miller indices? What is their importance?

12. Write down Bragg's equation and explain the symbols.

13. Give two properties of reciprocal lattice?

14. Write the expression for the Fermi - Dirac distribution function and explain.

15. Give the expression for dc conductivity and explain the symbols.

16. What is Weidmann - Franz law?

17. Explain forbidden energy gap.

18. Draw the energy level diagram of an n-type semiconductor and label it.

19. What is meant by local electric field? Give its expression.

20. What is dipolar polarizability? Give the expression and explain.

21. Distinguish between Ferromagnetism and Antiferromagnetism?

22. Give the Curie law of paramagnetism? What is the Curie temperature.

23. With the help of a diagram, explain Ferromagnetic domains.

24. Distinguish between type I and type II semiconductors.

25. Describe the Isotope effect in semiconductors.

26. Explain the BCS theory of superconductors.

(8 × 2 = 16 Marks)

SECTION – C

Answer any **six**; **each** carries **4** marks.

27. Write down the miller indices for planes if the intercepts are 3a, 3b and 2c

28. Show that for a simple cubic lattice, $d_{100}: d_{110}: d_{111} = 6^{1/2}:3^{1/2}:2^{1/2}$

29. Lead in the super conducting state has critical temperature of 6.2K at zero Magnetic. Field and a critical field of 0.064 T at oK. Determine the critical field at 4K.

30. The transition temperature of Mercury with an average atomic mass of 200.59 amu is 4.153K, determine the transition temperature of one of its isotopes $_{80}Hg^{204}$

31. Glancing angle for the first order spectrum was observed to be 8° in Bragg's x -ray spectrometer. Calculate the spacing between the planes if the wavelength used is 0.78 A°

32. Calculate the fermi energy of Sodium (bcc) where lattice constant= 4.3 A°

33. Derive the Clausius - Mossotti relation.

34. Calculate the critical current for a wire of lead having a diameter of 1mm at 4.2K. T_c for lead is 7.18K and $Hc(0) = 6.5 \times 10^4\ Am^{-1}$

35. Draw the planes (1 0 0), (0 0 I) and (1 1 1) of a cubic crystal.

36. Calculate the intrinsic conductivity of an intrinsic Germanium rod. The intrinsic carrier density at 300K is $2.37 \times 10^{19}\ m^{-3}$ and the motilities of electron and hole are 0.38 and 0.18 $m^2v^{-1}s^{-1}$ respectively.

37. Calculate the Hall coefficient of Sodium based on free electron model. Sodium has bcc structure and the side of the cube is 4.28 A°.

38. Derive Curie-Wesis law of ferromagnets.

(6 × 4 = 24 Marks)

SECTION – D

Answer any **two**; **each** question carries **15** marks.

39. Discuss the seven basic crystal systems in 3D. How many lattice points are there in SC, BCC and FCC.

40. Deduce Bragg's law in X ray diffraction. Describe Bragg's spectrometer and explain how it is used to determine wavelength of X - rays.

41. Explain superconductivity. Give any three properties of superconductors Give a qualitative description of the BCS theory.

42. Distinguish between dia, para and ferromagnetism. Derive an expression for the paramagnetic susceptibility on the basis of Langevin's classical theory.

43. Discuss the formation of allowed and forbidden energy bands on the basis of Kronig - Penny model.

44. Define Fermi energy & thaw the Fermi sphere. Derive an expression for Fermi energy of a system of free electrons.

(2 × 15 = 30 Marks)
