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Sixth Semester B.Sc. Degree Examination, March 2020

First Degree Programme Under CBCSS

Physics

Core Course IX

PY 1641 – SOLID STATE PHYSICS

(2013 Admission onwards)

Time : 3 Hours Max. Marks : 80

SECTION – A

Answer **all** questions. Each carries **1** mark.

1. What is a unit cell?
2. Define co-ordination number.
3. Give two advantages of neutron diffraction over x-ray diffraction.
4. Give the expression for Fermi Dirac distribution function.
5. What is free electron gas?
6. Define gyromagnetic ratio.
7. What are diamagnetic substances?
8. Define polarizability.

P.T.O.

9. What are color centres?

10. Define critical magnetic field.

(10 × 1 = 10 Marks)

SECTION – B

Answer **any eight** questions. Each carries **2** marks.

11. Give the relation between magnetic susceptibility, magnetization, and magnetic field.

12. Name the seven basic crystal systems.

13. Distinguish between ionic and covalent bond.

14. Explain Hall effect.

15. Show that the reciprocal lattice to the fcc lattice is bcc.

16. Write down the expression for fermi energy and explain the symbols.

17. Explain the failure of free electron model.

18. Define the Curie law of paramagnetism.

19. What is piezoelectricity? Explain.

20. Discuss the 3 sources of polarizability.

21. Explain Meissner effect.

22. Mention three important applications of superconducting materials.

(8 × 2 = 16 Marks)

SECTION – C

Answer any **six** questions. Each carries **4** marks.

23. Show that packing fraction of fcc is 0.74.

24. Show that for a simple cubic lattice, $d_{100} : d_{110} : d_{111} = \sqrt{6} : \sqrt{3} : \sqrt{2}$.

25. The 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 of radiation used is 0.78 A°.

26. The atomic radius of Sodium is 1.86 A°. Calculate the Fermi energy of Sodium at absolute zero, Given Sodium is bcc.

27. Lead in the superconducting state has critical temp of 6.2 K at zero magnetic field, and a critical field of 0.624 T at 0 K, determine the critical field at 4 K.

28. The optical index of refraction and the dielectric constant for water are 1.33 and 8.1 respectively. Determine the percentage of ionic polarizability.

29. Calculate the work function in electron volt, for Sodium metal, given that photo electric threshold wavelength is 6800 A°.

30. Prove that c/a ratio for an ideal hcp structure is 1.633.

31. The critical temp of mercury with an average atomic mass of 200.59 amu is 4.153 K. Determine the transition temp of one of its isotopes $_{80}Hg^{204}$.

(6 × 4 = 24 Marks)

SECTION – D

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

32. (a) Derive Bragg's formula in the diffraction of X-rays by crystals.

(b) Explain the rotating crystal method for crystal structure analysis.

33. (a) Discuss the Kronig-Penny model for the motion of an electron in a periodic potential.

(b) What is meant by density of energy states.

34. Describe Langevin's theory of paramagnetism and obtain an expression for paramagnetic susceptibility. Comment on the temperature dependence of susceptibility.

35. (a) What is superconductivity?

(b) Name three properties of superconductors?

(c) Briefly outline the BCS theory of superconductivity.

(2 × 15 = 30 Marks)