SUBJECT CODE :15PH/MC/SS54
B.Sc. DEGREE EXAMINATION NOVEMBER 2019
BRANCH III - PHYSICS
FIFTH SEMESTER

COURSE	**:**	**MAJOR – CORE**
PAPER	**:**	**SOLID STATE PHYSICS**
TIME	**:**	**3 HOURS**

MAX. MARKS :100

SECTION – A

ANSWER ALL QUESTIONS: (30x1=30)
Choose the correct answer:

1. Which of the following covalent compounds conduct electricity
   a) Silica   b) Graphite   c) Diamond   d) Hydrogen chloride

2. Condensed matter physics largely considers physical processes over what range of energies?
   a) μeV to eV b) meV to keV c) keV to MeV d) MeV to GeV

3. The solid which are brittle and hard are
   a) Ionic solid   b) molecular solid   c) covaland solid   d) metallic solid

4. When electrons are trapped in the crystal lattice in place of anion vacancy, the defect in the crystal is known as
   a) Non-stoichiometric defect   b) F-Centre
   c) stoichiometric defect   d) Frenkel defect

5. Burger's vector changes with
   a) type of dislocation   b) Length of dislocation
   c) Both type and length of dislocation   d) None

6. Stacking fault energies are in the range of
   a) $0.01\text{-}0.1 \text{ J/m}^2$ b) $0.01\text{-}0.1 \text{ J/cm}^2$ c) $0.1\text{-}10 \text{ J/m}^2$ d) $0.1\text{-}10 \text{ J/m}^2$

7. Which of the following is not an assumption in Drude-Lorentz theory of free electrons?
   a) Metals contain free electrons that move through a lattice of positive ions.
   b) Electric field produced by lattice ions is considered to be uniform throughout the solid and hence neglected.
   c) Free electrons in a metal resemble molecules of a gas and therefore the laws of kinetic theory of gases are applicable to free electrons.
   d) The electrons are distributed among the energy levels according to Pauli's exclusion principle.

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8. The resistivity of the material depends on which of the following.

   a) Length of the conductor   b) Area of cross section of the conductor

   c) Temperature   d) All the above

9. The quantized vibrations of lattice points in a solid are called

   a) Photons   b) Phonons   c) Protons   d) Partons

10. Typical thickness of Bloch walls _____ (nm).

   a) 0.1-1   b) 1-10   c) 10-50   d) 100

11. Example for para-magnetic materials

   a) super conductors   b) alkali metals   c) transition metals   d) Ferrites

12. Example for magnetic material used in data storage devices

   a) Permalloy   b) CrO_2 c) Cunife   d) Alnico

13. In superconductivity the conductivity of a material becomes

   a) Zero   b) Finite   c) Infinite   d) None of the above

14. The magnetic lines of force cannot penetrate the body of a superconductor, a phenomenon
    is known as

   a) Isotopic effect   b) BCS theory   c) Meissner effect   d) London theory

15.There are three important lengths which enter the theory of superconductivity except

   a) London penetration length   b) Intrinsic coherence length

   c) Normal electron mean free length   d) Mean path length

Fill in the blanks:
16. The major binding force in graphite is _____
17. Negative screw dislocation is represented by _____
18. Electrical conductivity of insulators is the range _____
19. Typical size of magnetic domains _____
20. The energy required to break a cooper pair is ___ of the energy gap of superconductor.

State whether true or false:
21. Dry ice is solid carbon.
22. Line defects are thermodynamically stable
23. When an electric field is applied to the metal, the free electrons are accelerated and they
    move in the opposite direction of applied electric field.

24. Ferromagnetic materials does not exhibit magnetization even in the absence of magnetic field.
25. Cryotron is a magnetically operated current switch.

Answer briefly:

26. What type of bonding do freshwater fish need to be thankful for?
27. What is a Schottky defect more commonly known as?
28. Give an expression for Hall co-efficient.
29. What is meant by transition (or) critical temperature?
30. What is meant by persistent current?

SECTION – B

Answer any Five Questions: (5x5=25)

31. Calculate the atomic vacancy concentration of Si crystal of room temperature (30°C) and at 800°C. The energy for vacancy formation of Si is 2.4 eV per atom. Atomic weight of Si is 28.09 and density of Si 2.33×10^3 kg/m^3.
32. What is Schottky and Frenkel defect?
33. The thermal and electrical conductivities of Cu at 20°C are 390 W m^{-1} K^{-1} and 5.87×10^7 Ω^{-1} m^{-1}, respectively. Calculate the Lorentz number.
34. The Hall coefficient and conductivity of Cu at 300 K have measured to be -0.55×10^{-10} m^3 A^{-1}s^{-1} and 5.9×10^7 mho per meter, respectively. Calculate the drift mobility of electrons in copper.
35. A paramagnetic material has a magnetic field intensity of 10^4 A m^{-1}, if the susceptibility of the material at room temperature is 3.7×10^{-3} calculate the magnetisation and flux density of the material.
36. The critical temperature for Hg with isotopic mass 199.5 at 4.184 K. Calculate the critical temperature when its mass changes to 203.4.
37. What are cooper pairs? Explain it.

SECTION – C

Answer any Three Questions: (3x15=45)

38. What is Hall effect? Derive an expression of Hall coefficient and mobility of charge carriers. Describe an experimental setup for the measurement of Hall coefficient.
39. Explain different types of crystal imperfection with neat sketches.
40. Deduce mathematical expression for electrical conductivity and thermal conductivity of a conducting material and hence obtain Wiedemann-Franz law.
41. Discuss the domain structure in ferromagnetic materials. Show how the hysteresis curve is explained on the basis of domain theory.
42. What is Meissner effect? Prove that all superconductors are perfect diamagnetic in superconducting state.

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