

STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 600 086.
(For candidates admitted during the academic year 2015-2016 and thereafter)

SUBJECT CODE :15PH/MC/SS54
B.Sc. DEGREE EXAMINATION NOVEMBER 2017
BRANCH III - PHYSICS
FIFTH SEMESTER

COURSE : MAJOR – CORE
PAPER : SOLID STATE PHYSICS
TIME : 3HOURS **MAX. MARKS :100**

SECTION – A

ANSWER ALL QUESTIONS: (30x1=30)

Choose the correct answer:

- Bond strength of secondary bonds is in the range of
(a) 1 kJ/mol (b) 10 kJ/mol (c) 100 kJ/mol (d) 1000 kJ/mol
- 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
- The solid which are brittle and hard are
(a) Ionic solid (b) molecular solid (c) covalent solid (d) metallic solid
- Thermodynamically stable defects
(a) Point defects (b) Line defects (c) Surface defects (d) Volume defects
- Burger's vector changes with
(a) Kind of dislocation (b) Length of dislocation
(c) Both kind and length of dislocation (d) None
- Stacking fault energies are in the range of
(a) $0.01-0.1 \text{ J/m}^2$ (b) $0.01-0.1 \text{ J/cm}^2$ (c) $0.1-10 \text{ J/m}^2$ (d) $0.1-10 \text{ J/m}^2$
- 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.
- 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
- The quantized vibrations of lattice points in a solid are called
(a) Photons (b) Phonons (c) Protons (d) Partons
- 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) CrO₂ (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 the following statements are true or false:

21. Ionic bond is not a strong bond
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. If 440×10^3 kJ of energy is required to break the H-H bonds in a K mol, Compute the energy required in eV to break one H-H bond.
32. What is Schottky and Frenkeldefet?
33. Calculate the electrical and thermal conductivities of a metal with the relaxation time of 10-14 second at 300 K. The electron density is $6 \times 10^{26} \text{ m}^{-3}$
34. The Hall coefficient and conductivity of Cu at 300 K have measured to be $-0.55 \times 10^{-10} \text{ m}^3 \text{ A}^{-1} \text{ s}^{-1}$ and 5.9×10^7 mho per mtere, respectively. Calculate the drift mobility of electrons in copper.
35. Define hysteresis. What is meant by hysteresis loop and What do you infer from it?
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 meant by bonding in solids? Explain the different types of bonds formed in the case of solids with suitable examples.
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 dia-magnet in superconducting state.
