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 2018
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:

1. If the atoms are displaced in two separate planes perpendicular to each other then it is called
   a) Edge Dislocation b) Burger's Dislocation c) Imperfections d) cracks
2. An extra atom in the interstice of the lattice is
   a) schottky defect b) frenkel defect c) impurity atom d) interstial atom
3. If a dislocation is caused by inserting an extra plane of atoms in the upper half of the crystal it is called _____
   a) screw dislocation b) positive dislocation
   c) negative dislocation d) Frenkel defect
4. The bonding in Diamond is
   a) covalent b) ionic c) metallic d) vanderwaals
5. The potential energy of sodium and chlorine ion when they are 0.2 nm apart is
   a) – 4.5 eV b)-7.2 eV c)5 eV d) 8 eV
6. The primary bonds are formed by
   a) intermolecular forces b) interatomic forces
   c) Vanderwaal type bonds d) dipole interaction between atoms
7. Hall co-efficient is
   a) $R_H = -\frac{1}{ne}$ b) $R_H = \frac{1}{ne}$ c) $R_H = ne$ d) $R_H = -ne$
8. Classical theory fails to explain _____
   a) Ohm's law b) ferro magnetism c) Compton effect d) both b & c
9. Thermal conductivity is inversely proportional to _____ of the electron
   a)Mass b) number c) collision time d) charge
10. The essential property of superconducting state is
    a)Ferromagnetism b) diamagnetism c)paramagnetism d) ferrimagnetism
11. Phonon is a quanta of
    a)electromagnetic energy b)thermal energy c) sound energy d) light energy
12. The width of the energy gap is maximum in a supeconductor at
    a) 0 K b) transition temperature c) curie temperature d) 5 K

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13. Paramagnetic materials when placed in a magnetic field move _____ field
    a)from weaker to strong point b) from strong to weaker point
    c) Parallel to the d) perpendicular to the

14. Langevin's theory failed to explain the relationship between _____
    a)Para and ferromagnetism b) para and ferrimagnetism
    c) para and diamagnetism d) ferro and ferrimagnetism
15. The diamagnetic susceptibility is independent of
    a) temperature b) permeability c) both (a) & (b) d) none of the above

Fill in the blanks:

16. The exponential form of the electronic specific heat is an indication of the existence of _____ in the energy spectrum.
17. According to Weiss the internal molecular field is proportional to the _____ of the material.
18. The magnitude and direction of the dislocation are defined by _____.
19. The bond length of secondary bonds are in the range of _____.
20. The _____ of magnetic susceptibility are used to determine the nature of the magnetic material.

State whether the following statements are true or false:

21. Type I superconductors are not completely diamagnetic.
22. Ferrimagnetic material have a net magnetization.
23. The potential energy of a stationary electron inside the metal is less than the potential energy of an electron outside the metal.
24. Presence of impurity atoms in the crystal lattice results in characteristic colours to the crystals.
25. The coefficient of thermal conductivity is directly proportional to velocity of the electron.

Answer briefly:

26. What is isotope effect.
27. Explain Domain wall energy.
28. State Wiedmann Franz law.
29. Define edge dislocation.
30. Define bond length.

SECTION – B

Answer any Five Questions: (5x5=25)

31. Calculate the critical current for a wire of lead having a diameter of 1 mm at 4.2 K. The critical temperature for lead is 7.18 K and $H_0 = 6.5 \times 10^5$ K.
32. The magnetic field intensity of ferric oxide is 10^6 A/m. If the susceptibility of the material is 1.5×10^{-3}, calculate the magnetization and flux density in the material.
33. If an average energy required to create a vacancy in a metal is 1eV, calculate the ratio of vacancies in a metal at 1000 and 500 K.
34. Calculate the cohesive energy of KCl from the following data r_0 (the equilibrium separation between the ion pair) = 0.314 nm, A=1.75, n=5.77, ionization energy of K= 4.1 eV, electron affinity of Cl=3.61 eV.
35. A copper strip 2mm wide and 2mm thick has Hall coefficient 10^{-2}m / coulomb. If for a current of 3mA the Hall voltage produced is 2mV, Calculate the strength of the magnetic field.
36. Explain Hysteresis loop of a ferromagnetic material on the basis of domain theory.
37. Derive an expression for electrical conductivity with the help of free electron theory.

SECTION – C

Answer any Three Questions: (3x15=45)

38. Derive an expression for cohesive energy of an ionic crystal. Calculate the cohesive energy for NaCl crystal. Explain the potential energy diagram of an ionic molecule.
39. What is Frenkel defect? Find an expression for the number of Frenkel defects present in a crystal.
40. Derive Langevin's theory of paramagnetism. Explain the Langevin curve.
41. Write short notes on
    a) BCS theory of superconductivity b. TYPE-I and TYPE-II superconductivity.
42. What is Hall effect? Derive an expression for hall coefficient, mobility and Hall angle. Explain how Hall coefficient can be determined experimentally.

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