STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI- 86

END SEMESTER EXAMINATION (ONLINE) - NOVEMBER 2021

SOLID STATE PHYSICS

CLASS: III B.SC. PHYSICS

SUBJECT CODE: 19PH/MC/SS54

SECTION-A

ANSWER ALL THE QUESTIONS

CHOOSE THE CORRECT ANSWER

The length of H – H bond is (in nm) _____. a) 0.074 b) 0.01 c) 0.037 d) 2 eV

- 2. A diamagnetic material has susceptibility
 - a) $\chi = 0$ b) $\chi \ge 0$ c) $\chi < 0$ d) $\chi > 1$

3. Which of the following are the properties of superconductors?

- a) They are diamagnetic in nature
- b) They have zero resistivity
- c) They have infinite conductivity
- d) All the above
- 4. A Copper strip 2.0 cm wide and 1.0 mm thick is placed in a magnetic field with B=1.5W/m² perpendicular to the strip. Suppose a current of 200 A is set up in the strip, what Hall potential difference would appear across the strip? (N=8.4x10²⁸ electrons/m³) a) 1.1 x 10⁻⁶ V b) 2.2 x 10⁻⁵ V c) 1.1 x 10⁻⁵ V d) 2.2 x 10⁻⁶ V

TIME: 3 HRS

MAX. MARKS: 100

(8x1=8)

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- Boundary between two parts of a closest packing having alternate staking sequence is called ______.
- a) Grain defect b) Staking fault c) Screw dislocation d) Lineage boundary 6. 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 7. The most important characteristics of ferromagnetic material is _____. a) Spontaneous magnetization b) Neel temperature c) Faraday's temperature d) Demagentization temperature 8. Phonon is a quanta of a) Electromagnetic energy b) Thermal energy c) Sound energy d) Light energy FILL IN THE BLANKS: (5x1=5)
 - 9. Vander Waals interaction varies with interatomic separation as rⁿ where n is
 - 10. _____ materials possess opposite moments of different magnitudes resulting in large magnetization.
 - 11. According to Weiss the internal molecular field is proportional to the ______ of the material.
 - 12. If *n*, v_d and *e* are density of electrons, the electron's drift velocity and its charge respectively, then the current density is _______.
 - 13. The sign of current carrying charges can be determined by ______ effect.

(7x3=21)

ANSWER BRIEFLY:

- 14. Distinguish between metallic bonds and covalent bonds?
- 15. Write the significance of Burger's vector.
- 16. What was the drawback of classical theory in explaining the specific heat capacity of solids?

- 17. Why anisotropy energy changes with domain wall thickness?
- 18. Differentiate Curie temperature and Neel temperature.
- 19. How does the critical magnetic field vary with temperature in type II superconductors?
- 20. Mention the unique properties of a superconductor.

SECTION B

ANSWER ANY FOUR QUESTIONS

- 21. A metallic wire has a resistivity of $1.42 \times 10^{-8} \Omega m$. For an electric field of 0.14 V/m. Find (i) average drift velocity and (ii) mean collision time, assuming that there are 6×10^{28} electrons/m³.
- 22. Calculate the cohesive energy and bond 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.
- 23. Explain the Schottky and Frenkel defects with neat diagram?
- 24. (i) A magnetic field strength of $2x10^5$ amperes/metre is applied to a paramagnetic material with a relative permeability of 1.01. Calculate the values of B and M.

(ii) A magnetic field of 1800 ampere/metre produces a magnetic flux of $3x10^{-5}$ weber in an iron bar of cross sectional area 0.2 cm². Calculate magnetic permeability.

25. Enumerate the properties of type I and type II superconductors.

SECTION C

ANSWER ANY ONE QUESTION

- 26. A. What is Hall effect? Give the theory of Hall effect. Describe the Hall effect experiment to determine the Hall coefficient of semiconductor. (15)
 - B. Explain the BCS theory of superconductivity. (15)
- 27. A. Explain metallic bond and properties of metallic solids. (15)

B. Derive the Langevin's theory of paramagnetism and obtain an expression for paramagnetic susceptibility. (15)

(4x9=36)

(1x30=30)