647510 **BSCsmsCC6020** **Seat No :_____**

B.Sc. Semester - 6 (*CBCS*) Examination
July-2025 (OLD COURSE)
STATISTICAL MECHANICS AND SOLID STATE PHYSICS(CORE)

Time: 2:30 Hours **Marks: 70**

Instructions:

1. All questions are compulsory.
2. Figures to the right indicate marks.

Que.1 (A) Answer the following questions (any one) (07)

1. Derive the distribution law of Bose-Einstein statistics.
2. Explain: Classical Maxwell-Boltzmann distribution law.

Que.1 (B) Answer the following questions (any one) (04)

1. Explain thermodynamic probability.
2. Explain Volume in phase space.

Que.1 (C) Answer the following questions (any three) (03)

1. ……. statistics is used in the case of distinguishable particles.
2. Which statistics is used for electrons?
3. Maxwell-Boltzmann statistics is classical statistics. [True/False]
4. ……. formula gives the approximate values of ln n!
5. The particles which obey Fermi-Dirac statistics are known as Boson. [True/False]

Que.2 (A) Answer the following questions (any one) (07)

1. Write a note on heat capacity of solids.
2. Explain in detail crystal lattice and lattice translation vector.

Que.2 (B) Answer the following questions (any one) (04)

1. Write a short note on metallic crystal.
2. Write a short note on diamond cubic structure.

Que.2 (C) Answer the following questions (any three) (03)

1. The Debye model is valid for short wavelengths. [True/False]
2. …… + Basis = Crystal structure.
3. Number of atoms in the unit cell of simple cubic structure is …….
4. NaCl is ……. type of crystal.
5. The substance that has a regular internal structure is called …….

Que.3 (A) Answer the following questions (any one) (07)

1. Write a note on Hall Effect. Also define Hall voltage and Hall coefficient.
2. Explain free electron gas in one dimension.

Que.3 (B) Answer the following questions (any one) (04)

1. Explain Wiemann-Franz law.
2. Derive the Boltzmann Equation.

Que.3 (C) Answer the following questions (any three) (03)

1. Write the equation of the Fermi wave vector for free electron gas in 3 dimensions.
2. Hamiltonian H = potential energy + ……. energy
3. At low temperatures the value of Lorentz number tends to increase. [True/False]
4. The energy of the top-most filled level at 0 K is known as ……. energy.
5. The relation between wave vector k and wavelength λ is given by equation k = ……..

Que.4 (A) Answer the following questions (any one) (07)

1. Describe the band structure of Silicon and Germanium.
2. Explain electron-hole carrier concentration.

Que.4 (B) Answer the following questions (any one) (04)

1. Explain the effect of impurities in semiconductors.
2. Explain: the electrical conductivity of intrinsic semiconductors.

Que.4 (C) Answer the following questions (any three) (03)

1. In N-type semiconductors holes are majority charge carriers. [True/False]
2. The equation of the Fermi-Dirac function is f (E) = …….
3. The unit of Energy band gap (E_g) is …….
4. The semiconductor without any doping is called intrinsic semiconductor. [True/False]
5. Forbidden gap is also known as ……..gap.

Que.5 (A) Answer the following questions (any one) (07)

1. Explain London's theory in detail.
2. Explain Josephson Effect.

Que.5 (B) Answer the following questions (any one) (04)

1. Write the applications of superconductivity.
2. Write a short note on Meissner effect.

Que.5 (C) Answer the following questions (any three) (03)

1. A Superconductor exhibits a perfect para-magnetism. [True/False]
2. The relation between critical magnetic field H_c and transition temperature Tc is Hc =……..
3. There are two types of superconductors. [True/False]
4. The first superconductor material discovered by Onnes is Nickel. [True/False]
5. At T_c resistance of the superconductor becomes …….

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