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

B.Sc. Semester - 6 (*CBCS*) Examination
March/April-2023 (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.

Q.1(A) Answer the following question. (Any One) **(07)**

1. Derive the distribution law of Fermi-Dirac statistics.

2. Derive the distribution law of Bose-Einstein statistics.

Q.1(B) Answer the following question. (Any One) **(04)**

1. Explain Volume in phase space.

2. Write a note on microstates and macrostates.

Q.1(C) Answer the following questions. (Any Three) **(03)**

1. ……. statistics is used in the case of distinguishable particles.

2. The minimum volume of cell in a phase space is ……..

3. Which statistics is used for photons?

4. ……. formula gives the approximate values of ln n!

5. The particles which obey Fermi-Dirac statistics are known as …….

Q.2(A) Answer the following question. (Any One) **(07)**

1. Write a note on heat capacity of solids.

2. Explain in detail crystal lattice and lattice translation vector.

Q.2(B) Answer the following question. (Any One) **(04)**

1. Explain Debye model.

2. Write a short note on metallic crystal.

Q.2(C) Answer the following questions. (Any Three) **(03)**

1. The Debye model is valid for ……. wavelengths.

2. Lattice +…… = Crystal structure.

3. A simple thermodynamic relation connecting C_p and C_v is C_p-C_v = …….

4. Si is ……. type of crystal.

5. The substance which has regular internal structure is called …….

Q.3(A) Answer the following question. (Any One) **(07)**

1. Write a note on Hall Effect. Also define Hall voltage and Hall coefficient.

2. Explain free electron gas in one dimensional box.

Q.3(B) Answer the following question. (Any One) **(04)**

1. Derive the Boltzmann Equation.

2. Explain density of states in one dimension.

Q.3(C) Answer the following questions. (Any Three) (03)

1. At low temperatures the value of Lorentz number tends to ……..
2. Hamiltonian H = …… energy + ……. Energy
3. Write the equation of Fermi wave vector for free electron gas in 3 dimensions.
4. The energy of 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 = ……

Q.4(A) Answer the following question. (Any One) (07)

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

Q.4(B) Answer the following question. (Any One) (04)

1. Explain donor states in semiconductors.
2. Explain the effect of impurities in semiconductors.

Q.4(C) Answer the following questions. (Any Three) (03)

1. In P-type semiconductors …….. are majority charge carriers.
2. The equation of Fermi-Dirac function is f (E) = …….
3. The unit of Energy band gap (E_g) is …….
4. The semiconductor obtained by doping impurities in pure semiconductor is called ……semiconductor.
5. Energy gap is also known as ……..gap.

Q.5(A) Answer the following question. (Any One) (07)

1. Explain Josephson Effect.
2. Explain: BCS theory.

Q.5(B) Answer the following question. (Any One) (04)

1. Write a short note on Meissner effect.
2. Explain influence of external agents on superconductivity.

Q.5(C) Answer the following questions. (Any Three) (03)

1. The transition temperature T_c of mercury is ……K.
2. The relation between critical magnetic field H_c and transition temperature T_c is H_c =……..
3. There are ……. types of superconductors.
4. The first superconductor material discovered by Onnes is……..
5. At T_c resistance of superconductor becomes …….

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