B. Sc. / M. Sc. (Applied Physics) (Sem. V) (CBCS) Examination

November - 2019

Statistical Physics-XVII

(New Course)

Time : $2\frac{1}{2}$ Hours]   [Total Marks : **70**

1   Attempt any SEVEN short questions (Two marks each)   **14**

    1.   Explain canonical ensemble.

    2.   Write the principle of equipartition of energy.

    3.   Write about the uses of ensembles.

    4.   What is thermodynamic probability ?

    5.   Prove that in a radiation cavity equilibrium number of photons $N = VT^3$.

    6.   What was the discrepancy in Einstein's specific heat model ?

    7.   Prove that for a classical case molar specific heat of solids follows Dulong-Petit law.

    8.   Write some typical data for white dwarfs.

    9.   Derive an equation for mean energy of fermions at $T = 0$ K.

    10.   What is chandrashekhar mass limit? Write its relation with mass of the Sun.

2   (A)   Write answers of any two

    1.   Write a brief note: phase space.

    2.   Discuss Statistical equilibrium and Grand canonical ensemble.

    3.   Derive the equations for the number of phase cell for harmonic oscillator and three dimensional free particles.

4. Derive the equation for volume in phase space

$$d\tau = \left(2m\right)^{\frac{3}{2}} \varepsilon^{\frac{1}{2}} d\varepsilon V$$

(B) Write answers of any one.

1. Prove : Sterling's Approximation.

2. Discuss thermal equilibrium and mechanical equilibrium.

3 Write answers of any two :   **14**

1. Derive general statistical distribution law and explain most probable distribution.

2. What is harmonic oscillator ? Derive an equation for mean energy of harmonic oscillator.

3. Derive equation for relation between partition function and thermodynamics in detail.

4. Derive an equation for number of phase cells in the volume element.

4 Write answers of any two :   **14**

1. Prove that radiation pressure for a photon gas is equal to one third of the energy density.

2. Derive Einstein equation for specific heat of solids.

3. Derive Debye's equation for specific heat of solids.

4. Explain in detail: Radiation density and emissivity of photon gas.

5 (A) Write answers of any two : **10**

      1. Derive an equation for Fermi energy of gas using Heisenberg's uncertainty principle.

      2. Derive an equation for pressure exerted by Fermi gas in a white dwarf.

      3. Discuss: Atomic nucleus as an ideal fermion gas.

      4. The molar mass of Lithium is 0.00694 and its density is 0.53×10^3 kg /M^3. Calculate the Fermi energy of the electrons.

(B) Write answers of any two : **4**

      1. Explain the main drawbacks of Drude's thory.

      2. What are the white dwarfs ?

      3. Discuss the Hertz sprung-Russel diagram for the brightness of stars.

      4. What is the ground state energy of a Fermi gas?

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