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PBA-003-04950001 Seat No. _____

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

November / December - 2018

Statistical Physics : Paper - XVII

(New Course)

Faculty Code : 003

Subject Code : 04950001

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

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

(1) What is Chandrashekhar mass limit? Write its relation with mass of the Sun.

(2) What is photon gas?

(3) What is spontaneous and stimulated emission?

(4) Write a brief note: white dwarfs.

(5) What is phonon gas?

(6) Explain the variation of probability of a particle in fermi energy level as a function of chemical potential using the characteristic graph.

(7) Write about the uses of ensembles.

(8) Define microstate and macrostate.

(9) Write the principle of equipartition of energy.

(10) In which conditions, an ensemble is said to be in statistical equilibrium?

2 (a) Write answers of any **two** : **10**

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

(2) Derive the equation for volume in phase space $d\tau = (2m)^{\frac{3}{2}} \varepsilon^{\frac{1}{2}} d\varepsilon V$.

(3) Discuss :

(i) microcanonical,

(ii) canonical ensembles.

(4) Describe :

(1) Statistical equilibrium

(2) Grand canonical ensemble.

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

(1) Write a brief note: phase space.

(2) What are the ensembles?

(3) What is thermodynamic probability?

(4) Derive an equation for a phase space of a three dimension oscillator.

3 (a) Write answers of any **two** : **10**

(1) Derive general statistical distribution law.

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

(3) Discuss the relation between partition function and thermodynamics in detail.

(4) Explain: thermodynamic probability.

(b) Write answer of any **one** : **4**

(1) Derive an equation for number of phase cells in the volume element.

(2) Explain three types of particles an assembly generally consists.

4 (a) Write answers of any **two** : **10**

(1) What is Bose-Einstein condensation? Derive an equation for Bose temperature.

(2) Discuss: emissivity of a photon gas.

(3) Derive an equation for the heat capacity of an ideal boson gas, $C_V = \left(\frac{T}{T_b}\right)^{\frac{3}{2}}$.

(4) Derive Einstein equation for specific heat of solids.

(b) Write answer of any **one** : **4**

(1) Prove that in a radiation cavity equilibrium number of photons $N = VT^3$

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

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

(1) The molar mass of Lithium is 0.00694 and its density is $0.53 \times 10^3\ kg/m^3$. Calculate the Fermi energy of the electrons.

(2) Calculate the Fermi energy in eV for sodium assuming that it has one free electron per atom.
Given: Density of sodium $= 0.097\ gm/cm^3$
Atomic weight of sodium = 23

(3) Write a detailed note : Fermi gas in metals.

(4) Derive an equation for Fermi energy of gas using Heisenberg's uncertainty principle.

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

(1) What was the discrepancy in Einstein's specific heat model?

(2) Explain the main drawbacks of Drude's theory.

(3) Derive an equation for mean energy of fermions at $T = 0\ K$

(4) Discuss the Hertz sprung-Russel diagram for the brightness of stars.