LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

**M.Sc.** DEGREE EXAMINATION - **PHYSICS**

FIRST SEMESTER – NOVEMBER 2010

# PH 1815 / 1810 - STATISTICAL MECHANICS

Date : 09-11-10 Dept. No. Max. : 100 Marks

Time : 1:00 - 4:00

**Part – A**

Answer all questions ( 10 x 2 = 20 )

1. What is the form of second law of thermodynamics when the number of particles of the system under observation is not a constant?
2. What is meant by correct Boltzmann counting?
3. Evaluate the integral
4. What is grand canonical potential? Express grand canonical partition function in terms of the potential.
5. Why does liquid 3He show super fluidity even though 3He molecules are Fermions.
6. The pressure exerted by a Boson gas below the critical temperature is independent of its volume. Substantiate this statement.
7. Why does the electronic heat capacity dominate the atomic heat capacity at very low temperatures?
8. Is nuclear matter degenerate or not? Justify your answer.
9. Define mean square deviation.
10. The ensemble of a large system approximates a microcanonical ensemble. Substantiate this statement.

**Part – B**

**Answer any four questions ( 4 x 7.5 = 30 )**

1. a) What is a Slater determinant? How is Pauli’s exclusion principle incorporated into the Fermion wave function? (5)

b) In a one dimensional box of length 2a, a particle with constant velocity is mirror reflected at the walls. Draw its phase trajectory. (2.5)

1. Obtain the grand canonical distribution function.
2. Derive Stefan Boltzmann law for black body radiation.
3. Derive an expression for the magnetic susceptibility of a free electron gas.
4. Obtain an expression for the concentration fluctuation in grand canonical ensemble.

**Part – C**

**Answer any four questions ( 4 x 12.5 = 50 )**

1. a) State and prove Liouville’s theorem. (10)

b) Explain the principle of conservation of extension in phase. (2.5)

1. Obtain the expression for the entropy of an ideal gas by the method of canonical ensemble.
2. What is Bose-Einstein condensation? With necessary theory and relevant diagram show how the BE distribution function varies as temperature decreases below the transition temperature.
3. Explain the theory for the specific heat capacity of liquid helium below transition temperature.
4. Applying the theory of one dimensional random walk, show that a system of Brownian particles concentrated at the origin x=0 at time t=o, spread out with time.

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