 LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

FIRST SEMESTER – **APRIL 2012**

# PH 1815 - STATISTICAL MECHANICS

Date : 02-05-2012 Dept. No. Max. : 100 Marks

Time : 9:00 - 12:00

**PART - A**

**Answer ALL questions: (10x2=20)**

1. What is the degree of freedom of a system of N diatomic molecules
2. What is meant by correct Boltzmann counting?
3. What is the statistical weight associated with the distribution , for a grand canonical ensemble.
4. Differentiate between density of states g(є) and degeneracy gi.
5. Why does 3He show super-fluidity even though it is a Fermion?
6. What would be the pressure exerted by a Boson gas on the walls of the container at absolute zero? Justify your answer.
7. Define the term Fermi energy.
8. What is meant by thermionic emission? Define work function of a metal.
9. Why is statistical thermodynamics unsuitable for a small system at low temperatures?
10. Define the correlation function for a randomly fluctuating quantity.

**PART - B**

**Answer any FOUR questions: (4x7.5 = 30)**

1. Explain Gibb’s paradox. How is it resolved?
2. Obtain the partition function of a system with rotational, vibrational and electronic degrees of freedom.
3. Derive Planck’s radiation law. Show that the partition function for an oscillator defined by
4. Derive an expression for the magnetic susceptibility of a free electron gas.
5. Obtain Einstein’s result for the energy fluctuations of black body radiation. What is the implication of the result?

**PART - C**

**Answer any FOUR questions: (4x12.5 = 50)**

1. State and prove Liouville’s theorem. Express the equation of motion of a phase point in Poisson’s bracket notation.
2. a) Obtain Grand canonical distribution function. (6.5)

b) Consider an ideal gas in a grand canonical ensemble. Show that its fugacity is directly proportional to concentration. (6)

1. Explain the phenomenon of BE condensation. Why do only Bosons and no other particles exhibit it? Show how the distribution of Bosons varies with temperature.
2. Show that the specific heat capacity of an ideal Fermi gas is directly proportional to temperature when the temperature is very small compared to its Fermi temperature
3. Discuss Brownian motion in one dimension and obtain an expression for the particle concentration as a function of (x, t). Explain how Einstein estimated the particle diffusion constant.