LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – **PHYSICS**

FIRST SEMESTER – **APRIL 2014**

PH 1815 - STATISTICAL MECHANICS

Date : 07/04/2014 Dept. No. Max. : 100 Marks

Time : 09:00-12:00

PART A

Answer **ALL** the questions (10 × 2 = 20)

1. What is an ergodic surface?
2. State any two postulates of Statistical Mechanics.
3. What is grand canonical potential? Express grand canonical partition function in terms of the potential.
4. Write down the canonical partition function of a three level system of energies – ε, 0 and ε.
5. Distinguish between Bosons and Fermions.
6. What are rotons?
7. Define Fermi temperature.
8. Sketch the Fermi-Dirac distribution law for an ideal gas at absolute zero and at a temperature slightly above absolute zero.
9. Why does small particles immersed in a fluid show Brownian motion?
10. State Nyquist theorem.

PART – B

Answer any **FOUR** questions (4 × 7.5 = 30)

11. Obtain the condition for mechanical equilibrium between two systems
12. State and prove equipartition theorem.
13. Explain BE condensation. Discuss the super-fluidity of liquid helium in terms of boson condensation.
14. Derive an expression for the electronic contribution to specific heat capacity of a metal. Why is this contribution insignificant at high temperature?
15. Obtain an expression for the energy fluctuation in a canonical ensemble.

PART – C

Answer any **FOUR** questions (4 × 12.5 = 50)

16. Calculate the entropy of an ideal gas using microcanonical ensemble. From this, obtain the equation of states.
17. i) Calculate the entropy of an ideal gas using grand canonical ensemble.
    ii) Apply Bose-Einstein distribution law to photon gas and derive the Planck's formula for energy density of black-body radiation.
18. Explain the theory for the specific heat capacity of liquid helium below transition temperature.

19. Discuss the variation of the thermodynamical properties of a fully degenerate Fermi gas with temperature.
20. Derive the Boltzmann transport equation. Use it to find the distribution function in the absence of collisions.