# LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

FIRST SEMESTER – NOVEMBER 2016

**PH 1815 - STATISTICAL MECHANICS**

Date: 04-11-2016 Dept. No. Max. : 100 Marks
Time: 01:00-04:00

## Section – A

**Answer all the questions.** **(10 x 2 = 20 Marks)**

1. Define the term 'equal-a-priori-probability'.
2. Write down the form of second law of thermodynamics for a system for which the number of particles in not a constant.
3. State the theorem of equipartition of energy.
4. Sketch Maxwell's velocity distribution.
5. Why Fermions do not condense?
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. Why do electron gas shows only a very small magnetic susceptibility?
9. Give Einstein's relation for the particle diffusion constant.
10. Why does small particles immersed in a fluid show Brownian motion?

## Section – B

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

11. Prove that Phase trajectory of a harmonic oscillator is an ellipse. Hence draw the phase trajectory of a damped harmonic oscillator.
12. Obtain the rotational partition function of a diatomic molecule.
13. Apply the BE statistics to photons and obtain Planck's formula for the energy density of black body radiation.
14. Discuss quantum Hall effect.
15. Define i) correlation function and ii) spectral density of a randomly fluctuating quantity. Explain with example.

## Section – C

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

16. Calculate the entropy of an ideal Boltzmann gas using micro canonical ensemble. Explain the corrections to be made to obtain the Sakur-Tetrode equation and thus obtain the correct entropy of the system.
17. Explain the theory for the specific heat capacity of liquid helium below transition temperature.
18. 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.
19. Obtain an expression for the variation of chemical potential of a degenerate Fermi gas and demonstrate the result using graph.
20. Obtain the expressions for the mean square velocity and mean square displacement of a Brownian particle employing method of random walk. Graphically represent the variation of these quantities with time.

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