LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

FIRST SEMESTER – APRIL 2010

PH 1815 / 1810 / 1801 - STATISTICAL MECHANICS

Date & Time: 30/04/2010 / 1:00 - 4:00 Dept. No. Max. : 100 Marks

PART – A

(Answer **ALL** questions) (10 x 2 = 20 marks)

1. What is meant by phase-space? Define the term phase trajectory.
2. Define an ensemble. What is a stationary ensemble?
3. Write down the Maxwell Boltzmann and Fermi Dirac distribution functions.
4. What is the total energy of a system of five non-interacting particles at temperature T, if the Hamiltonian of the system is H = $\sum_{i=1}^{5} aP_{x_i}^2 + bx_i^2$?
5. What is the statistical weight associated with a grand canonical ensemble of M elements for the distribution, $\{m_{n_i}\}$?
6. What is the mechano-caloric effect exhibited by Liquid He II?
7. Give the reason why phonons cannot be polarized while photons can be polarized.
8. Define the term 'Fermi energy'.
9. Why is statistical thermodynamics unsuitable for small systems at low temperatures?
10. Why does small particles immersed in a liquid show Brownian motion?

PART – B

(Answer any **FOUR** questions) (4 x 7.5 = 30 marks)

11. Explain Gibb's paradox. How is it resolved?
12. Prove that entropy is an extensive property of the system.
13. Obtain the rotational partition function for a diatomic molecule.
14. Derive an expression for the magnetic susceptibility of a free electron gas.
15. Explain the correlation function of a randomly fluctuating quantity.

PART – C

(Answer any **FOUR** questions) (4 X 12.5 = 50 marks)

16. a) State and prove Liouville's theorem.
    b) What is the principle of conservation of extension in phase?
17. Obtain the expression for the entropy of a system of ideal gas when it exchanges energy with its surroundings, but not mass.
18. What is Bose-Einstein condensation? Show how a system of Bosons condense, when cooled below the critical temperature.
19. Define Chandrasekhar limit. Treating the white dwarf like an ideal Fermi gas, obtain an expression for it.
20. Obtain the expressions for the mean square velocity and mean square displacement of a Brownian particle employing Langevin theory. Graphically represent the variation of these quantities with time.

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