LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

THIRD SEMESTER – APRIL 2017

PH 3814- STATISTICAL MECHANICS

Date: 06-05-2017 Dept. No. Max. : 100 Marks
01:00-04:00

SECTION – A

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

1. Draw the phase diagrams of a harmonic oscillator & a damped harmonic oscillator.
2. Distinguish between macroscopic and microscopic states of a system.
3. State virial theorem.
4. Write down the canonical partition function of a system of n identical particles distributed in two energy levels ε_1 & ε_2.
5. What do you mean by critical opalescence?
6. What is grand canonical potential? Express grand canonical partition function in terms of it.
7. Why does ^{3}He show super-fluidity even though it is a Fermion?
8. State Rayleigh-Jean's law.
9. Define Fermi energy, Fermi momentum and Fermi temperature.
10. Show that entropy of an ideal Fermi gas is always greater than that of an ideal Boltzmann gas.

SECTION – B

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

11. Demonstrate that two different ideal gases when separated are more highly ordered than when they are mixed.
12. Obtain the thermodynamic parameters for a classical harmonic oscillator in the canonical ensemble.
13. From statistical point of view, show that for a system in equilibrium with a particle-energy reservoir, the probability is given by $P_r = \frac{e^{-\alpha N_r - \beta E_s}}{\sum e^{-\alpha N_r - \beta E_s}}$
14. Discus the thermodynamic properties of an ideal Bose-Einstein gas at low temperature.
15. Derive the Richardson-Dushman equation for thermionic emission.
16. Show that the $\langle U \rangle$ in canonical ensemble is the same as that in the micro canonical ensemble.

SECTION – C

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

17. State and prove Liouville's theorem.
18. From a discussion on the thermodynamics of magnetic systems, account for the significance of the negative temperature.
19. Outline the Einstein's theory of specific heat capacity.
20. Calculate all the thermodynamic properties of an ideal gas using grand canonical partition function and hence obtain the EOS.
21. Derive Planck's radiation law for a black body. Show that Wein and Rayleigh -Jeans laws are special cases of Planck's law. Derive Wien's displacement law.
22. Show that mass of a white dwarf star cannot be larger than a limiting mass known as Chandrasekar limit.

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