LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

THIRD SEMESTER – **APRIL 2016**

PH 3814 - STATISTICAL MECHANICS

Date: 30-04-2016 Dept. No. Max. : 100 Marks
Time: 09:00-12:00

SECTION – A

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

1. What is meant by phase-space? Define phase trajectory.
2. Define an ensemble. What is meant by a stationary ensemble?
3. Express the ensemble average <f> of any physical quantity f(q,p) in canonical ensemble.
4. Write down the canonical partition function of a two level system of energies 0 and ε.
5. Define density operator in quantum statistics.
6. Show that parity operator can have only two eigen values.
7. Why is the transition from He I to He II known as lambda transition?
8. What is the significance of the critical temperature for an ideal Bose gas?
9. Why is Pauli paramagnetic susceptibility independent of temperature?
10. Does the energy of a Fermi gas become zero at absolute zero? Substantiate your answer.

SECTION – B

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

11. Prove that Phase trajectory of a harmonic oscillator is an ellipse.
12. Calculate the entropy of an ideal gas using canonical partition function.
13. Find the energy fluctuation in grand canonical ensemble.
14. Explain BE condensation. Discuss the super-fluidity of liquid helium in terms of boson condensation.
15. Discuss the thermodynamic properties of weakly degenerate Femi gas.
16. Show that the mean energy U in the canonical ensemble is the same as in the micro canonical ensemble.

SECTION – C

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

17. Explain Gibb's paradox. How is it resolved?
18. State and prove equi-partition theorem.
19. Obtain the thermodynamic parameters for a system of quantum harmonic oscillator in the canonical ensemble.
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 of radius $>>10^8$ cm, its size is inversely proportional to its mass.

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