

LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034  
M. Sc. DEGREE EXAMINATION – PHYSICS  
FIRST SEMESTER – NOVEMBER 2003  
**PH 1801 / PH 721 – STATISTICAL MECHANICS**

06.11.2003  
1.00 – 4.00

Max. : 100 Marks

**PART – A**

Answer ALL the questions.

(10 x 2 = 20)

01. Distinguish between micro states and macro states.
02. What is meant by stationary ensemble?
03. Distinguish between canonical and grand canonical ensembles.
04. How does the vibrational contribution to the specific heat of a system vary with temperature?
05. What is the significance of the temperature  $T_0$  for an ideal Bose-Einstein gas?
06. Sketch the Fermi-Disc distribution function for a gas in 3-d at  $T = 0$  and at  $T > 0$ .
07. What are white dwarfs?
08. What is the implication of Einstein's result for the energy fluctuations of black body radiation?
09. Give the relations which represent the Wiener-Khintchine theorem.
10. Write down the Boltzmann transport equation.

**PART – B**

Answer any FOUR questions.

(4 x 7.5 = 30)

11. State and explain the basic postulates of statistical mechanics.
12. Obtain the Sackur-Tetnode equation by considering an ideal gas in canonical ensemble.
13. Apply the Bose-Einstein statistics to photons and obtain Planck's law for black body radiation. Hence obtain the Stefan-Boltzmann law.
14. Show that the specific heat of an ideal Fermi-Dirac gas is directly proportional to temperature when  $T \ll T_F$ .

15. Calculate the energy fluctuation for a canonical ensemble. Show that if the fluctuations are very small, it is practically a micro canonical ensemble.

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**PART – C**

Answer any FOUR questions.

(4 x 12.5 = 50)

16. a) Prove Liouville theorem.

b) Explain Gibbs paradox and discuss how it is resolved.

(5 + 7.5)

17. a) Show that Boltzmann counting appears as a natural consequence of the symmetry of wave function in quantum theory. (5)

b) Discuss the features of Gibbs canonical ensemble. Derive an expression for the probability distribution of the canonical ensemble. (7.5)

18. a) Discuss the thermodynamic properties of an ideal Bose-Einstein gas. (7.5)

b) How does Landau explain the super fluidity of He<sup>4</sup> using the spectrum of phonons and rotons? (5)

19. a) Show that the fractional fluctuation in concentration is smaller than the MB case for FD statistics and larger for BE statistics. (7.5)

b) State and explain Nyquist theorem. (5)

20. Obtain the Boltzmann transport equation. Using it determine the distribution function in the presence of collisions.

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