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**NY—122—2023**

**FACULTY OF SCIENCE**

**M.Sc. (Second Semester) EXAMINATION**

**NOVEMBER/DECEMBER, 2023**

**(New/CBCS Pattern)**

**PHYSICS**

**Paper–202**

**(Statistical Mechanics)**

**(Friday, 8-12-2023)**

**Time : 10.00 a.m. to 1.00 p.m.**

*Time—3 Hours*

*Maximum Marks—75*

*N.B. :—* (i) Attempt *all* questions.

(ii) Each question carries equal marks.

(iii) Figures to the right indicate full marks.

1. (a) Explain first and second order phase transition. 7
- (b) Explain the phenomenon of B-E condensation using B-E distribution law at  $T < T_0$ . 8
- Or*
- (c) Critical exponents in phase transition. 7
- (d) State and explain Landau's theory of liquid He. 8
2. (a) Obtain energy and pressure of a strongly degenerate F-D gas at  $T = 0$ . 7
- (b) Discuss about phase space, phase trajectory and phase volume. 8
- Or*
- (c) Calculate entropy of a perfect gas in microcanonical ensemble. 7
- (d) Derive Clausius-Clapeyron equations of phase transition. 8

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3. (a) Derive an expression for M-B distribution law for velocity of particles. 7
- (b) Derive an expression for Planck radiation formula for energy density of a perfectly black body. 8

*Or*

- (c) Derive an expression for Virial equation of state and obtain Virial coefficients. 7
- (d) Show that :
- (i) The rate of change of density in phase space is constant or  $\frac{d\rho}{dt} = 0$ .
- (ii) The volume at the disposal of a particular number of phase points is conserved throughout the phase space or  $\frac{d(\delta\Gamma)}{dt} = 0$ . 8

4. (a) Explain the principle of equipartition of energy and derive an expression for mean energy of a particle per degree of freedom. 7
- (b) What is Gibbs' paradox and how can it be removed ? 8

*Or*

- (c) Distinguish between Microcanonical, Canonical and Grand canonical ensembles. 7
- (d) Derive M-B distribution law for the distribution of particles obeying M-B statistics and also obtain partition function from it. What will be the degeneracy if the distribution is classical ? 8

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5. Write short notes on (any *three*) : 15

- (i) Richardson-Dushman equation for thermionic emission
- (ii) Brownian motion
- (iii) Tisza's two fluid model
- (iv) Difference between particles obeying M-B, B-E and F-D statistics.

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