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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

P.T.O.

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 Microcananical, 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

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.