BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION SP/2025)

CLASS: INT. M.Sc **SEMESTER : VI**
BRANCH: PHYSICS **SESSION : SP/2025**

SUBJECT: PH316 STATISTICAL MECHANICS

TIME: 02 Hours **FULL MARKS: 25**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 5 marks and total 25 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates**

			CO	BL
Q.1(a)	What is meant by an ensemble ? Mention the different types of ensembles with examples.	[2]	1	1
Q.1(b)	3 particles are to be accommodated in 4 non-degenerate energy states. Calculate the number of possible micro-states if the particles obey: (i) Maxwell-Boltzmann statistics (ii) Fermi-Dirac statistics (iii) Bose-Einstein statistics	[3]	1	2,3
Q.2(a)	What is phase-space ? Determine it for a linear harmonic oscillator and plot it.	[2]	1	1,2
Q.2(b)	Derive the distribution function obeyed by a system of N particles with total energy E given the fact that the particles are identical and distinguishable.	[3]	1	3
Q.3(a)	Define partition function (Z). Compute it for a classical, ideal gas of N atoms confined to a volume V and having total energy E.	[2]	1	1,2
Q.3(b)	Show that the Gibbs Free energy (G) is related to the partition function (Z) as: $G = \left(\frac{-1}{\beta}\right)\left[Ln(Z) - \left(\frac{\partial Ln(Z)}{\partial Ln(V)}\right)\vert_{T,N}\right]$	[3]	1	3
Q.4(a)	What is Gibbs paradox ? What is the reason behind its occurrence ?	[2]	1	1,2
Q.4(b)	Write down the Sackur-Tetrode equation and show that it resolves the Gibbs paradox.	[3]	1	3
Q.5(a)	Define equipartition theorem. Prove it for a generic system with Hamiltonian H(p,q).	[2]	1	1,2
Q.5(b)	Calculate the expression for specific heat at constant volume (C_v) for a solid assuming it to be made of N identical harmonic oscillators. Explain its behavior at low and high temperatures.	[3]	1	3

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