BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: IMSC/MSC **SEMESTER : VIII/II**
BRANCH: PHYSICS **SESSION : SP/2023**

SUBJECT: PH408 STATISTICAL PHYSICS

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1	Define negative temperature, fluctuation-dissipation theorem, electron degeneracy pressure, metastable states and critical exponents?	[10]	1,2,3	1
Q.2(a)	Suppose the energy of an anharmonic oscillator is given by $H = \frac{P^2}{2m} + bx^{2n}$ where n is a positive integer and n > 1. Consider a thermodynamic system consisting of a large number of these identical noninteracting oscillators. Derive the single oscillator partition function.	[5]	2	3
Q.2(b)	Show that the heat capacity is $C = N K_B/2\,(1 + 1/n)$ for the above problem	[5]	2	3
Q.3(a)	Find the critical temperature, pressure and volume at which the Van der Waals isotherm has an inflection point.	[5]	3	2
Q.3(b)	Using Landau theory, discuss the phase transition of a system from a paramagnetic state to a ferromagnetic state.	[5]	3	2
Q.4(a)	Compute the partition function of a one-dimensional Ising chain in absence of a magnetic field.	[5]	4	3
Q.4(b)	Explain the formulation and outcomes of Curie-Weiss mean field theory.	[5]	4	4
Q.5(a)	Write down the Langevin equation for a Brownian particle and discuss the properties of the fluctuating force.	[5]	5	2
Q.5(b)	Derive the fluctuation-dissipation theorem for a Brownian particle.	[5]	5	3

::::::25/04/2023::::::E