Name: **Enrolment No:**	

UPES

End Semester Examination, May 2024

Course: Statistical Physics **Semester: IV**

Program: BSc. Hons. Physics **Time : 03 hrs.**

Course Code: PHYS 2028 **Max. Marks: 100**

Instructions: All questions are compulsory. There are internal choices in Q9 and Q11.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Define phase space and determine the phase path of a one-dimensional harmonic oscillator.	**4**	**CO1**
Q 2	Calculate the number of quantum states available to a proton inside a nucleus (radius= 10^{-14} m) whose momentum cannot exceed 10^{-19} kgms^{-1}	**4**	**CO2**
Q 3	Comment on the following statement: "The liquid nitrogen in a closed laboratory Dewar flask approximates to being a member of a microcanonical ensemble."	**4**	**CO1**
Q 4	Show that the radiation enclosed in a thermally insulated enclosure is independent of the nature and shape of the walls of enclosure.	**4**	**CO2**
Q 5	Define the concept of critical temperature in phase transitions.	**4**	**CO1**
	SECTION B **(4Qx10M= 40 Marks)**		
Q 6	Specify the quantum states of four spin (1/2) non-interacting particles in a tabular form mentioning the total magnetic moment and degeneracy of each state if magnetic moment is μ_0 for spin up and $-\mu_0$ for spin down.	**10**	**CO1**
Q 7	Obtain Curie's law for a paramagnetic substance having N magnetic atoms per unit volume placed in an external magnetic field B assuming that only two energy levels, with energies $-\mu_B B$ and $+\mu_B B$ will be available to the system. (Here μ_B is the intrinsic magnetic moment.)	**10**	**CO3**
Q 8	What is radiation pressure? Find the radiation pressure for (a) normal incidence of radiation on a surface and (b) diffused radiation.	**10**	**CO2**
Q 9	Derive Planck's radiation formula and obtain Wein's constant $b = \lambda_m T$ from it. OR For an adiabatic expansion of radiation in a cavity, find the relations $\lambda V^{-1/3}$ = constant and $TV^{1/3}$= constant and hence prove the Wein's displacement law.	**10**	**CO2**

SECTION-C (2Qx20M=40 Marks)			
Q 10	An atom has two energy states. Set up an equation for the ratio N_1/N_2, if the atoms obey Bose-Einstein statistics, where N_1 and N_2 are the numbers of atoms in the ground and excited states respectively. Discuss what happens when Bose-Einstein condensation sets in.	**20**	**CO3**
Q 11	What do you understand by strongly degenerate quantum systems? Discuss the case of a completely degenerate Fermi gas using appropriate expressions and diagrams and derive the expression for internal energy in terms of fermi energy. OR What is a white dwarf star? Show that a white dwarf star can be considered as a completely degenerate Fermi gas. Derive the expression for energy for a white dwarf star using relativistic treatment.	**20**	**CO4**