Reg. No ..... Name **26P255**

M. Sc. DEGREE END SEMESTER EXAMINATION - APRIL 2026

SEMESTER 2 : PHYSICS

COURSE : **24P2PHYT08 : THERMODYNAMICS AND STATISTICAL MECHANICS**

(For Regular 2025 Admission and Improvement/Supplementary 2024 Admission)

Time : Three Hours Max. Weights: 30

PART A

Answer any 8 questions **Weight: 1**

1.	Calculate the increase in entropy when 2 systems at different temperatures thermalize.	(U)
2.	Write down the normal/Gaussian probability distribution.	(U)
3.	Explain the partition function in the grand canonical ensemble.	(U)
4.	Write down the expression for de-Broglie wavelength. Explain the terms involved.	(U)
5.	Obtain C_p for a triatomic gas.	(U)
6.	Discuss Fermi distribution function at absolute zero via plot.	(U)
7.	What was the limitation of Rayleigh-Jeans theory for blackbody radiation?	(U)
8.	What is Landau theory in phase transitions?	(U)
9.	Show that for a single mole of an ideal gas $C_P = C_V + R$.	(A)
10.	Write down the expression for density of states D(k)dk for a single particle in one dimension.	(U)

(1 x 8 = 8)

PART B

Answer any 6 questions **Weights: 2**

11.	Obtain C_p for a diatomic gas.	(U)
12.	If the probability of hitting a target is 0.1 and ten shots are fired independently, what is the probability that the target will hit at least once?	(A)
13.	Discuss grand potential and derive the expressions for S, P and <N> .	(U)
14.	Show that the entropy S(k) for a fermi particle vanishes when the fermi distribution function n(k) goes to zero or 1.	(U)
15.	A kilogram of water has a constant heat capacity of 4.2 $KJKg^{-1}K^{-1}$ over the temperature range 0^0C to 100^0C. The water starts at 0^0C and is brought into contact with a heat bath at 100^0C. When the water has just thermalized at 100^0C what is the change in the entropy of the water and that of the universe.	(A)
16.	A system has 2 energy levels with an energy gap of $3.2x10^{-21}$ J; the upper level is twofold degenerate, the lower level is occupied if the system is in thermal contact with a heat bath at a temperature of 150 K?	(A)
17.	Calculate the temperature at which there is 1 % probability that a state with an energy 0.5 eV above the Fermi energy will be occupied by an electron.	(A)
18.	Consider the reaction $3O_2 \leftarrow\text{---}\rightarrow 2O_3$. Identify the stoichiometric coefficients. What is the condition for chemical equilibrium between oxygen and ozone?	(U)

(2 x 6 = 12)

PART C

Answer any 2 questions **Weights: 5**

19. Derive the expression for dP/dT when we have phase coexistence on a phase boundary line. (U)

20. Obtain the expression for the Maxwell's distribution of molecular speeds and hence arrive at the expression for average kinetic energy of each particle. (U)

21. State and prove equipartition theorem. (U)

22. Obtain the expression for Magnetization for a spin system. (U)

(5 x 2 = 10)

OBE: Questions to Course Outcome Mapping

CO	Course Outcome Description	CL	Questions	Total Wt.

Cognitive Level (CL): Cr - CREATE; E - EVALUATE; An - ANALYZE; A - APPLY; U - UNDERSTAND; R - REMEMBER;