Reg. No ..... Name **25U605**

B. Sc. DEGREE END SEMESTER EXAMINATION - MARCH 2025

SEMESTER 6 : PHYSICS

COURSE : **19U6CRPHY09: THERMAL AND STATISTICAL PHYSICS**

(For Regular 2022 Admission and Supplementary 2021/2020/2019 Admissions)

Time : Three Hours Max. Marks: 60

PART A

Answer any 8 (2 marks each)

1. What is an Ensemble in Statistical Mechanics? Name the major types of it.
2. What do you undertstand by thermodynamic variables and equation of state of the thermodynamic system.
3. Describe briefly two different practical black bodies.
4. Why does the temperature of a gas drops when it is subjected to adiabatic expansion? Explain.
5. What is equipartition theorem in Statistical Mechanics?
6. Use Maxwell's thermodynamic relations to obtain Mayer's relation for an ideal gas.
7. What is a Grand-Canocial Ensemble in Statistical Mechanics?
8. Show that during reversible adiabatic process the entropy of the system remains constant.
9. Prove that PV^{γ}= constant in a adiabatic transformation.
10. State Zeroth law of thermodynamics. Explain its importance.

(2 x 8 = 16)

PART B

Answer any 6 (4 marks each)

11. A Carnot engine has its source at 100 ^{O}C and its sink is maintained at a constant temperature by means of ice at 0 ^{O}C. If it is working at the rate of 100 watts, how much ice will melt in one minute? (Latent heat of ice is 80 kCal/kg).
12. A black sphere of diameter 8 cm, is heated to 500 K when the surrounding temperature is 300 K. What is the rate at which energy is radiated? Stefan's constant is 6 x 10^{-8} $Wm^{-2}K^{-4}$
13. A gas occupying 1 litre at 80 cm of Hg pressure is expanded adiabatically to 1190 c.c. If the pressure falls to 60 cm of Hg in the process, deduce the value of γ.
14. Calculate the change in the boiling point of water when the pressure of steam on its surface is increased from 1 atmosphere to 1.10 atmospheres. Latent heat of water at 100 ^{O}C = 537 cal/g. Volume of one gram of steam at 100 ^{O}C = 1676 cm^3.
15. A quantity of air at 27 ^{O}C and atmospheric pressure is suddenly compressed to half its original volume. Find the final (i) pressure and (ii) temperature. (Given γ = 1.4 and $2^{1.4}$ = 2.64).
16. What is meant by Partition function (Z) and show via mathematical steps how average energy of the system is related to Z?
17. A motor car tyre has a pressure of 2 atmosphere at the room temperature of 27 ^{O}C. If the tyre suddenly bursts, find the resulting temperature.
18. Differentiate between the Maxwell Boltzmann Distribution function and Fermi Dirac Distribution Function.

(4 x 6 = 24)

PART C

Answer any 2 (10 marks each)

19. i) State and explain four laws in thermodynamics? ii) Explain indicator diagram and its uses.
20. What are black body radiation. Explain the salient features of black body radiation spectrum, hence outline Wien's displacement law and Rayleigh – Jeans law with special reference to ultraviolet catastrophe.
21. Describe adiabatic process in detail and obtain expressions for the following: i) equation of adiabatic process in term of P and V, P and T; and V and T, ii) work done in adiabatic process, and iii) cooling caused in adiabatic expansion.
22. Derive Fermi Dirac Distribution function.

(10 x 2 = 20)