Reg. No ..... Name **23U605**

B. Sc. DEGREE END SEMESTER EXAMINATION : MARCH 2023

SEMESTER 6 : PHYSICS

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

(For Regular - 2020 Admission and Supplementary - 2019 Admission)

Time : Three Hours Max. Marks: 60

PART A

Answer any 8 (2 marks each)

1. What is meant by the term " principle of equal apriori probability"?
2. Why do we need ensembles in statistical Mechanics?
3. What are the properties of the walls separating the various individual systems in the MicroCanonical ensemble?
4. State Boyle's law. Comment on the significance of Boyle temperature (T_B).
5. Describe briefly i) isobaric process ii) isochoric process iii) adiabatic process iv) isothermal process.
6. What necessitated the modification of ideal gas equation? Briefly explain.
7. State first law of thermodynamics and show that it is a particular form of general law of conservation of energy.
8. From the relevant Maxwell's thermodynamic equation, obtain Clausius-Clapeyron equation. Explain the use of the equation.
9. Describe the conditions under which various thermodynamic potentials are constant.
10. State Wiedmann-Franz law. Explain.

(2 x 8 = 16)

PART B

Answer any 6 (4 marks each)

11. What is meant by Partition function (Z) and show via mathematical steps how average energy of the system is related to Z?
12. Considering 4 identical and distinguishable balls to be distributed in 2 identical boxes, discuss the various possible macrostates and identify the most probable macrostate.
13. 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 $\gamma = 1.4$ and $2^{1.4} = 2.64$).
14. For water vapor near critical point, the Van der Waal's constants and gas constant are: $a = 0.199$ Pa. m^6 mol^{-2}, $b = 1.83 \times 10^{-5}$ m^3/mol, $R = 5.008$ J/mol/K. Find the parameters of the critical state.
15. A heat engine working between two temperatures could theoretically convert one-eighth of the heat supplied into work. If the lower temperature is reduced by 95 ^{O}C, the theoretical efficiency would be doubled. Find the initial temperatures.
16. A quantiy of dry air at 27 ^{O}C is compressed (i) slowly and (ii) suddenly, to 1/3 of its volume. Find the change in temperature in each case, assuming γ to be 1.4 for dry air.
17. The opposite faces of a metal plate of 0.2 cm thickness are at a difference of temperature of 100 ^{O}C and the area of the plate is 200 sq.cm. Find the quantity of heat that will flow through the plate in one minute if K = 0.2 CGS unit.
18. Calculate the change in entropy when 10 g of water at 60 ^{O}C is mixed with 30 g of water at 20 ^{O}C.

(4 x 6 = 24)

PART C
Answer any 2 (10 marks each)

19. Derive Maxwell Boltzmann Distribution function.
20. State and prove Carnot's theorm. Show that it is a necessary consequence of second law of thermodynamics. Hence obtain the efficiency of a Carnot engine using an ideal gas as working substance.
21. What do you understand by critical constants of real gas? Explain briefly. Obtain expressions for three critical constants in terms of Van der Waal's constants.
22. Explain the physical significance of the thermodynamic variable "Entropy". Describe the entropy changes in reversible and irreversible processes and hence explain the principle of increase of entropy.

(10 x 2 = 20)