**Name of the Department : Physics and Astrophysics**

**Name of the Course : B.Sc. Prog.–CBCS_Core**

**Name of the Paper : Thermal Physics and Statistical Mechanics**

**Semester : III**

**Unique Paper Code : 42224303**

**Question paper Set Number: A**

**Duration:3 hours** **Max Marks: 75**

**Attempt any FOUR questions of this question paper. Each question is of 18.75 marks.**

1. (a) Define extensive and intensive variables with the help of examples. Explain how first leads to the concept of internal energy law of thermodynamics. (8)

(b) Draw P-V diagrams representing isothermal and adiabatic process of an ideal gas. Why is P-V curve for adiabatic process steeper than that for isothermal process (5)

(c) Deduce the latent heat equation of Clausis $C_2 - C_1 = (dL/dT) - (L/T)$ where $C_1$ and $C_2$ represent the specific heat of a liquid and its saturated vapour and L is the latent heat of the vapour. (5.75)

2. (a) State Carnot's theorem and show that it is necessary consequence of second law of thermodynamics. Using Carnot theorem, prove Clausis inequality. (12)

(b) There are two Carnot engines A and B operating in two different temperature regions. For Engine A the temperatures of the two reservoirs are 200°C and 150°C. For engine B the temperatures of the reservoirs are 300°C and 250°C. Which engine has lesser efficiency? (6.75)

3.(a) Define the principle of increase of entropy. Explain the second law of thermodynamics in terms of entropy? (6.75)

(b) Using the Maxwell's law of distribution of molecular speed; derive expression for:

i. Average speed

ii. Most probable speed

iii. Root mean square speed (12)

4. (a) Using Maxwell's thermodynamic relations, show that the ratio of adiabatic and isothermal elasticity is equal to ratio of molar specific heat at constant pressure and volume.

(12)

(b) Find the change in entropy when 1 gram of water at $0^{o}C$ is converted into steam at 100 $^{o}C$. The specific heat of water is 1cal/gm $^{o}C$ and latent heat of steam at 100 $^{o}C$ is 540 cal/gm.

(6.75)

5 (a) Derive Wein's displacement law and Stefan's law from Planck's radiation law. (10.75)

(b) Explain the ultraviolet catastrophe according to Rayleigh-Jeans distribution law. (5)

(c) A body at 1500 K emits maximum energy of wavelength 2000 nm. If the sun emits maximum energy of wavelength 550 nm, what would be the temperature of the sun? (3)

6. (a) Define and explain the terms Macrostate and Microstate with the help of an

example. (6)

(b)What is meant by the term thermodynamic probability of macrostate? How it is related to probability of occurrence of that state. How does it differ from mathematical probability?

(8.75)

(c) 4 molecules are to be distributed in 2 cells. Find possible no. of macrostates and corresponding no. of microstates. (4)