[This question paper contains 2 printed pages.]

Sr. No. of Question Paper : 1907 **GC-3** **Your Roll No.....**

Unique Paper Code : 42224303

Name of the Paper : Thermal Physics and Statistical Mechanics

Name of the Course : **B.Sc. (Physical Sciences) CBCS : Physics – III**

Semester : III

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on the receipt of this question paper.
2. Attempt **Five** questions in all.
3. Question No. **1** is compulsory.
4. **All** questions carry equal marks.

1. Attempt any **five** of the following : (5×3=15)

   (a) State First law of thermodynamics & explain each of its terms.

   (b) Derive the expression for work done during an isothermal process.

   (c) Write the expression of Claussius-Clapeyron's First Latent heat equation. Using this, discuss the effect of pressure on boiling point of a liquid.

   (d) Explain the T-S diagram of a Carnot's Cycle.

   (e) Define mean free path of a gas molecule. How does it vary with temperature and pressure.

   (f) From Wein's displacement law, estimate the temperature of the Sun, given $\lambda_m = 4900 \times 10^{-7}$ cm and Wein's constant 0.292 cm K.

   (g) Define the terms "Microstate" and "Macrostate" of a thermodynamical system.

2. (a) State and prove Carnot's theorem.

   (b) A Carnot's engine whose low temperature reservoir is at 7°C has an efficiency of 50%. It is desired to increase the efficiency to 70%. By how many degrees should the temperature of high-temperature reservoir be increased. (10,5)

P.T.O.

3. (a) Give Kelvin Planck and Claussius' statements of second law of thermodynamics and prove their equivalence.

   (b) Prove that Entropy change during a reversible process is zero. (10,5)

4. (a) Using thermodynamic potentials, derive Maxwell's four relations.

   (b) Using appropriate Maxwell's relation deduce;

   (i) $C_p - C_v = T\left(\frac{\partial P}{\partial T}\right)_V \left(\frac{\partial V}{\partial T}\right)_P$

   (ii) $\left(\frac{\partial U}{\partial V}\right)_T = T\left(\frac{\partial P}{\partial T}\right)_V - P$ (7,8)

5. Explain the porous – plug experiment in detail and derive the expression for temperature of inversion. (8,7)

6. (a) Derive Maxwell's velocity distribution law, stating the assumptions. Hence derive the probability of finding the number of molecules having energy between ε and $\varepsilon + d\varepsilon$.

   (b) Discuss experimental verification of Maxwell's velocity distribution law. (10,5)

7. (a) Give Planck's quantum postulates.

   (b) Drive Stefan's law and Wien's displacement law from Planck's law of black body radiation.

   (c) What is the wavelength of maximum intensity of radiation radiated from a source at temperature 3000°C ? Wien's constant = 2.898×10^{-3} mK. (3,9,3)

8. (a) Explain the term "Degeneracy". Differentiate between Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics.

   (b) Derive Maxwell-Boltzman distribution law for a system of an ideal gas containing n molecules. (5,10)