This question paper contains 2 printed pages. *Your Roll No. .....*

Sl. No. of Ques. Paper : **1524** **F–7**

Unique Paper Code : **2222301**

Name of Paper : **Thermal Physics**

Name of Course : **B.Tech. (Polymer Science) (FYUP)**

Semester : **III**

Duration : : **3 hours**

Maximum Marks : **75**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt five questions in all including Question No. 1 which is compulsory.

All questions carry equal marks.

1. Attempt any *five* of the following : 5x3=15

   (a) Distinguish between extensive and intensive thermodynamic variables, with examples.

   (b) State conditions for reversibility of a process.

   (c) Calculate the work done for a quasistatic adiabatic process for an ideal gas.

   (d) State the third law of thermodynamics. Show that it leads to unattainability of absolute zero.

   (e) What is the advantage of T-S diagram over P-V diagram of a Carnot cycle?

   (f) What is Transport phenomenon in gases?

   (g) A gas is allowed to expand adiabatically from 10 litres to 30 litres at an initial temperature of 300 K. Calculate the work done.

2. (a) Show that the violation of Clausius statement leads to violation of Kelvin-Planck statement of Second law of thermodynamics. 7

   (b) Prove :
   $C_p - C_v = T E_t \alpha_p^2 V$,
   where E_t is isothermal elasticity and α_p is isobaric coefficient of volume expansion. 8

3. (a) Prove that for any substance, the ratio of adiabatic and isothermal elasticities is equal to the ratio of the two specific heats. 5

   (b) Describe construction and working of Carnot's reversible heat engine. Derive expression for its efficiency. 10

P.T.O.

4. (a) Explain the four thermodynamic potentials U, F, H and G. Derive Maxwell relations from them. 10

(b) Derive the two Energy equations in thermodynamics. 5

5. (a) What is entropy? Show that the entropy of a system remains constant during a reversible process, whereas it increases during an irreversible process. 9

(b) One mole of an ideal gas undergoes a reversible isothermal expansion from V_1 to $2V_1$.
(i) What is the change in entropy of the gas?

(ii) What is the change in entropy of the universe? 6

6. (a) Define mean free path λ of the molecules of a gas. If d is the diameter of each molecule and n is the no. of molecules per unit volume, derive expression for λ, using first order approximation. 7

(b) Apply Kinetic theory of gases to obtain an expression for the coefficient of diffusion of gases. 8

7. (a) Using Maxwell-Boltzmann law of distribution of velocities for molecules in an ideal gas, derive the expressions for the following:
(i) Most probable speed (C_m)
(ii) Average speed (C_{avg})
(iii) Root mean square speed (C_{rms}), and show that
$C_{rms} > C_{avg} > C_m$ 15

8. (a) Draw curves for the distribution of energy in the spectrum of black body for temperatures T_1 and T_2 where $T_1 < T_2$. Discuss the important conclusions drawn from these curves. 7

(b) Derive Planck's radiation formula for a black body. Show that Wein's law and Rayleigh-Jean's law can be deduced from it. 8

Values of constants $R = 8.31\ J\ mol^{-1}K^{-1}$