[This question paper contains 3 printed pages.]

4607 *Your Roll No.* .....

B.Sc. Prog./II **AS**

PH–202 – PHYSICS (THERMAL PHYSICS AND OPTICS)

(Admissions of 2008 & onwards)

Time : 3 Hours *Maximum Marks : 75*

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

Attempt any **Five** *questions.*
All *questions carry equal marks.*

1. Using the characteristics of Perfect Differentiability of the Thermodynamical Variables p, v, s and T, establish the equality of the Jacobians :

$$\begin{vmatrix} \frac{\partial T}{\partial x} & \frac{\partial T}{\partial y} \\ \frac{\partial s}{\partial x} & \frac{\partial s}{\partial y} \end{vmatrix} = \begin{vmatrix} \frac{\partial p}{\partial x} & \frac{\partial p}{\partial y} \\ \frac{\partial v}{\partial x} & \frac{\partial v}{\partial y} \end{vmatrix}$$

Hence deduce all the Maxwell and Thermodynamic Relations. (6,6,3)

2. Using Maxwell Relations deduce the following :

(i) $p + \left(\frac{\partial U}{\partial V}\right)_T = T\left(\frac{\partial p}{\partial T}\right)_V$ for a real gas

P.T.O.

(ii) $(\partial U/\partial V)_T = 0$ for a Perfect gas

(iii) $\frac{E_S}{E_T} = \gamma$ (5,5,5)

3. Explain reversible and irreversible processes with examples. Also discuss the reversibility of a Carnot cycle. Hence show that the efficiency of a carnot engine is given by :

$$\eta = 1 - \left(\frac{1}{\rho}\right)^{\gamma - 1}$$ (3,3,9)

4. What are Transport Phenomena in gases ? Apply Kinetic Theory of gases to obtain an expression for the coefficient of Thermal Conductivity of gases. Show that :

$$\frac{KM}{\eta C_v} = 1$$ (4,7,4)

5. State and prove the Boltzmann Theorem :

$$S = k \ln W$$

Using this theorem, obtain the equation of state of a Perfect Gas. (7,8)

6. (a) Giving the theory of Interference of Light in thin films, deduce the relation :

$$2 \mu d \cos\theta = n\lambda.$$

(b) A soap film 5×10^{-5} cm thick is viewed at an angle of 35° to the normal. Find the wavelengths of light in the visible spectrum which will be absent from the reflected light ($\mu = 1.33$). (8,7)

7. Answer any **three** parts :

(a) Show that Wien's Law and Rayleigh Jeans Law are particular cases of Planck's Law of Black Body Radiation.

(b) A Carnot Engine working as a refrigerator between 260 K and 300 K receives 500 calories of heat from the reservoir at the lower temperature. Calculate the amount of heat rejected to the reservoir at the higher temperature. Calculate also the amount of work done in each cycle to operate the refrigerator.

(c) Discuss various aspects of Second Law of Thermodynamics showing the directional characteristics of heat radiation.

(d) What is Thermodynamic Equilibrium ? Give a detailed discussion of differences in the characteristics of Internal Energy, Heat Energy and Mechanical Energy of a Thermodynamic System. (5,5,5)