This question paper contains 4 printed pages]

Roll No. | | | | | | | | | | | |

S. No. of Question Paper : **1518**

Unique Paper Code : **222263** **E**

Name of the Paper : **Phys. II Thermal Physics (PHPT-202)**

Name of the Course : **B.Sc. (Physical Sciences)**

Semester : **II**

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.

Question No. **1** is compulsory.

All questions carry equal marks.

The symbols used in this paper have usual meanings.

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

   (*a*) Define extensive and intensive thermodynamic variables with examples.

   (*b*) Explain the concept of temperature using Zeroth law of thermodynamics.

   (*c*) Why is it not possible to obtain absolute zero ? Explain.

   (*d*) Derive an expression for the work done by an ideal gas during adiabatic expansion.

P.T.O.

(*e*) Using the expression of coefficient of viscosity, discuss its dependence on pressure and temperature of the gas.

(*f*) Calculate the value of :

$$\gamma\left(=\frac{C_p}{C_v}\right)$$

for helium gas.

(*g*) Discuss that good absorbers are good emitters.

2. (*a*) Write down Kelvin-Planck and Clausius statements of second law of thermodynamics. Show that both statements are equivalent.

(*b*) A reversible heat engine converts one sixth of the heat input into work. When the temperature of the sink is reduced by 62°C, its efficiency is doubled. Calculate the temperatures of source as well the sink. 10,5

3. (*a*) Define entropy and discuss its physical significance. Show that entropy does not change during a cyclic reversible process and always increases during an irreversible process.

(*b*) Obtain an expression for the change in entropy when ice changes into stream. 12,3

4. (*a*) What are thermodynamic potentials ? Derive Maxwell's thermodynamic relations using thermodynamic potentials.

(*b*) Calculate the change in melting point of ice when it is subjected to a pressure of 100 atmospheres [Given : density of ice = 0.92 g/cm^3, latent heat of fusion = 80 cal/g]. 12,3

5. Deduce the expression for Joule-Thomson coefficient 'μ' : 9,6

$$\mu = \left(\frac{\partial T}{\partial P}\right)_H$$

$$= \frac{1}{C_p}\left[T\left(\frac{\partial V}{\partial T}\right)_P - V\right]$$

And by using Maxwell's relations show that for a real gas :

$$\mu = \frac{1}{C_p}\left(\frac{2a}{RT} - b\right)$$

6. (*a*) Draw a plot of spectral energy density with wavelengths at different temperatures for a black body and explain the plot.

(*b*) Discuss briefly the different laws which explain the above energy spectrum.

(*c*) Calculate the wavelength at which human body radiates maximum energy. Take body temperature as 37°C (Given : Wien's constant $b = 2.898 \times 10^{-3}$ m–K).

8,4,3

P.T.O.

7. (*a*) Derive Maxwell-Boltzmann distribution law of velocity. How is this law verified experimentally ?

(*b*) Calculate the root mean square velocity of hydrogen molecule at 27°C. [Given : $k_B = 1.38 \times 10^{-23}$ J/deg and mass of hydrogen molecule is 3.34×10^{-27} kg]. 13.2

8. (*a*) What are transport phenomena ? Obtain the expression for the coefficient of thermal conductivity of a gas.

(*b*) Calculate the mean free path of a gas molecule whose diameter is 3 Å and number of molecules per unit volume is 3×10^{25} m^{-3}. 12.3