

**2022**

**3rd Semester Examination**

**PHYSICS (General)**

**Paper : DSC 1C/2C/3C-T**

**[Thermal Physics and Statistical Mechanics]**

**[CBCS]**

Full Marks : 40

Time : Two Hours

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers*

*in their own words as far as practicable.*

**Group - A**

1. Answer any *five* questions : 2×5=10

- (i) Write down the third law of thermodynamics.
- (ii) What is Brownian motion ?
- (iii) Explain the degrees of freedom of a dynamical system.
- (iv) What is quasistatic process ? Give an example.
- (v) Write down the physical significance of entropy.
- (vi) Write down the principle of equal or apriori probability.

P.T.O.

(vii) Define partition function in thermodynamics.

(viii) Mention some corrections which are needed for ideal gas equation.

2. Answer any **four** questions :

5×4=20

(i) Calculate the change in entropy if we mix 786 gm water at 27°C with 275 gm water of 86°C. Prove

$$\text{that } TdS = C_p dT - T \left( \frac{\partial V}{\partial T} \right)_p dP. \quad 3+2$$

(ii) Write down the basic assumptions of kinetic theory of gas.

Write down the principle of equipartition of energy. Calculate the average energy per degrees of freedom of an ideal classical gas. 2+1+2

(iii) If the molecular diameter of hydrogen is  $1.9 \times 10^{-8}$  cm., find the number of collisions by a hydrogen molecule in 1s, if  $T = 300$  K,  $P = 1$  atmos.

Calculate the work done by 1 mole of an ideal gas for isothermal expansion from a volume  $V_0$  to  $10 V_0$  at a temperature of 273 K. 3+2

(iv) Define reversible and irreversible processes. State and prove Carnot's theorem. 2+3

(v) Derive Maxwell's relation in thermodynamics from thermodynamic energy consideration. 5

( 3 )

- (vi) Define canonical and micro-canonical ensembles.  
Derive the relation  $S = k \ln W$ ; between entropy ( $S$ )  
and probability ( $W$ ). 2+3

3. Answer any *one* question : 10×1=10

- (i) Write down the assumptions of Planck's black body radiation. What is ultraviolet catastrophe ?  
Derive the Planck's law of radiation and plot the energy distribution. Also derive Wien's law and Rayleigh-Jeans law from Planck's law.

2+1+3+2+2

- (ii) Calculate the number of elementary phase cells available to the  $n$ , particles having degeneracy  $g$ , at a temperature  $TK$ . Derive Fermi-Dirac distribution formula for 'n' fermions attained a thermal equilibrium at  $TK$  temperature. Briefly explain the distinction between the three statistics i.e. B.E., F.D. and M.B. statistics. What is Gibb's paradox ?

2+3+3+2

### বঙ্গানুবাদ

১। যেকোন পাঁচটি প্রশ্নের উত্তর দাও : ২×৫=১০

- (i) তাপগতিবিদ্যার তৃতীয় সূত্রটি লেখ।  
(ii) ব্রাউনীয় গতি কি ?  
(iii) গতিশীল পদ্ধতির স্বাধীনতার মাত্রা বলতে কি বোঝ ?

P.T.O.