

FYUGP/3rd Sem/25(NEP)New

2025

Four Year Under Graduate Programme (FYUGP)

3rd Semester Examination (Under NEP)

(New Session 2024-25)

PHYSICS (Major)

Paper Code : PHSMJ DC-301

(Thermal Physics - I)

Full Marks : 30

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.*

1. Answer any six questions :

1×6=6

(a) State the law of equipartition of energy.

(b) Find out the dimension of entropy.

(c) Define isentropic process and give an example.

(d) State Clausius theorem in thermodynamics.

(e) Explain why specific heat of a gas at constant pressure is greater than specific heat at constant volume.

(f) What do you mean by r.m.s. speed of gas molecules?

P.T.O.

(g) Define 'Intensive' thermodynamic variable with an example.

(h) What is the value of the temperature gradient if heat flows from a region at 100°C to 50°C over a distance of 10 cm?

2. Answer any *three* questions :

3×3=9

(a) Write three important features of the Maxwell-Boltzmann distribution law.

(b) Calculate the work done by 1 mole of gas during an isothermal expansion from a volume V_1 to V_2 , when the equation of state is

$$pV = RT\left(1 - \frac{B}{V}\right), \quad B = f(T).$$

(c) A substance of unit mass with latent heats L_1 and L_2 at the melting and boiling points T_1 and T_2 respectively, has specific heat C given by,

$$C = AT^{\frac{1}{2}} + BT^{-1}, \quad \text{where } A \text{ and } B \text{ are constants.}$$

Find the change in entropy of the system when it is converted to the vapour state at T_2 from the solid state at T_1 .

(d) Sketch the Maxwell-Boltzmann distribution of speeds for a gas at two different temperatures, T_1 and T_2 (where $T_2 > T_1$). Briefly explain the sketch.

1+2

(3)

- (e) Show that for a perfect gas during adiabatic process, $PV^\gamma = \text{constant}$, symbols have their usual meanings.

3. Answer any *three* questions : 5×3=15

- (a) (i) Show that for an adiabatic transformation of an ideal gas

$$p^{1-\gamma}T^\gamma = \text{constant},$$

where all the symbols have their usual meaning.

- (ii) Why is it impossible to reach absolute zero by a finite number of processes? Explain with an example. 2½+2½

- (b) Define first order and second order phase transitions with examples. Graphically show the behaviour of Gibbs free energy, entropy and specific heat around the transition point. 2+3

- (c) Calculate the efficiency of a Carnot engine that is working between two constant temperatures T_1 and T_2 ($T_1 > T_2$).

- (d) (i) Write the one-dimensional Fourier's heat conduction equation. Solve the Fourier equation for steady-state conduction through a plane wall of thickness d with temperatures θ_1 and θ_2 at its surfaces.

P.T.O.

(4)

(ii) At what temperature will the r.m.s. speed of a gas be half its value at 0°C ? 3+2

(e) Write down four Maxwell's relations in Thermodynamics. Using the relations, obtain the Clausius-Clapeyron equation. 2+3
