LOYOLA COLLEGE (AUTONOMOUS) CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – **PHYSICS**

THIRD SEMESTER – **NOVEMBER 2024**

PH 3505 – THERMODYNAMICS

Date: 13-11-2024   Dept. No. ____   Max. : 100 Marks

Time: 09:00 am-12:00 pm

SECTION A

Answer ANY FOUR of the following   **4 x 10 = 40 Marks**

1. Explain the transport phenomena in gases. Derive an expression for the mean free path and discuss its significance in kinetic theory.
2. Derive the expression for pressure exerted by an ideal gas using the kinetic theory of gases. Discuss the assumptions made in the derivation.
3. Discuss the coefficient of viscosity, thermal conductivity, and diffusion of gases. Derive the relevant expressions for each.
4. Discuss the first law of thermodynamics. Derive the relation between internal energy and enthalpy for an ideal gas.
5. Derive the Mayer's relation Cp−Cv=RC for an ideal gas.
6. Describe Andrew's work on CO2 and discuss the concept of critical temperature.
7. Derive Clausius-Clapeyron's equation and explain its application in phase transitions. Discuss how it is used to determine latent heat.
8. Explain Maxwell-Boltzmann statistics and its application to a monoatomic ideal gas. Derive an expression for the specific heat capacity of such a gas.

SECTION B

Answer ANY THREE of the following   **3 x 20 = 60 Marks**

9. Explain Maxwell's distribution of molecular velocities. Describe an experiment that verifies this distribution.
10. Explain the second law of thermodynamics and the concept of entropy. Derive the Clausius inequality and explain its significance in irreversible processes.
11. Describe the Linde process for the liquefaction of gases. Explain the principle of regenerative cooling and how it is integrated into the Linde process. Discuss the challenges involved in liquefying gases like oxygen, hydrogen, and helium.
12. Compare and contrast He I and He II phases of helium. Discuss the phenomenon of superfluidity and its implications for low-temperature physics.
13. Discuss Planck's quantum theory and derive the formula for black body radiation. Explain how Planck's theory corrected the limitations of classical theories like Rayleigh-Jean's law.
14. State the principle of equipartition of energy and derive its implications for the degrees of freedom in an ideal gas. Using the energy distribution function, show how the equipartition theorem leads to the specific heat capacities of monoatomic and diatomic gases.