

B.Sc Part II

Sem IV

Paper - Thermodynamics and Statistical Physics

UNIT-I

1. What is a partition function?
2. State second law of thermodynamics given by Kelvin and Clausius?
3. Explain effect of pressure on melting point of substance?
4. Explain why efficiency of a Carnot engine cannot be 100%?
5. Explain Carnot theorem?
6. State first law of thermodynamics?
7. A Carnot engine operates between 227°C and 27°C . Calculate the adiabatic expansion ratio of the ideal gas ($\gamma=1.50$) used on it?
8. Explain the transport phenomena in gases?
9. Describe Carnot Cycle and deduce the expression for the network done in Carnot Cycle and deduce efficiency of Carnot engine?
10. Using Maxwell thermodynamics relation, derive Clausius-Clapeyron equation. Use it to explain the effect of pressure on melting point and boiling point of solids and liquids?
11. Derive the thermodynamic temperature scale using Carnot engine principle and explain that how it is related with ideal gas temperature scale?
12. Explain Internal energy (U), Helmholtz free energy (F), Enthalpy (H) and Gibbs free energy (G) thermodynamical potentials. Hence deduce Maxwell's four thermodynamic relations.
13. Explain microscopic and macroscopic system.
 1. Explain different types of interaction with matter.
 2. State the zeroth law of thermodynamics.
 3. Explain entropy and derive its expression.
 4. Explain partition function. Find probability of find any system in canonical ensemble is $P = \frac{e^{-\beta E}}{Z}$.
5. A Carnot engine of 1000 KW work between 490 K and 290 K. Calculate (a) absorbing heat (b) efficiency.
6. A Carnot engine absorbs 1000 calories at 500 K. It emits 400 calories heat to the sink. Find the temperature of sink.
7. Explain effect of pressure on melting point and boiling point on water by using of Clausius-Clapeyron equation.
8. Explain pressure vs temperature curve for water, also explain triple point.
9. Derive Joule Thomson expression by using of Maxwell equation.

UNIT-II

- 1.State the law of Maxwell law of velocity distribution and describe the method of verifying this law?
2. Derive the formula for average velocity, root mean square velocity and most probable velocity of molecules as per Maxwell velocity distribution law
3. What is degree of freedom of a gas? How much degree of freedom for a diatomic gas?
4. Define the principle of equipartition of energy and its application ?
- 4.How much specific heat of a vibrating diatomic molecule?
- 5.Obtain an expression for specific heat of a vibrating diatomic molecule and discuss its variation with temperature?
- 6.. Establish Barometric equation on the basis of Maxwell-Boltzmann Statistics?
7. What is mean free path? Obtain an expression for it.How does it depends on the density , pressure and temperature of gas.
8. Explain transport phenomenon in gases. On the basis of kinetic theory of gases drive an expression for the coefficient of thermal conductivity, viscosity?

UNIT-III

- 10.What is Joule-Thomson effect? Describe the Porous Plug experiment and prove that in the throttling process of Joule-Thomson experiment, the Enthalpy of a gas remains constant. Also, explain the conditions for heating and cooling effect
- 11.What do you mean by temperature of inversion?
- 12.Prove that the after passing through porous plug, there is no change in temperature of real gases
- 13..Determine the temperature of inversion of helium gas (given: $a=0.003\text{N-m}^4/\text{mol}^2$, $b=0.0237*10^{-3}\text{ m}^3/\text{mol}$, $R=8.31\text{ J/mol-K}$)
- 14.Describe the principle of regenerative cooling?Explain the method of regenerative cooling and derive formula if the efficiency of regenerative cooling.
- 15.What is adiabatic demagnetization?Describe the method of producing low temperature with necessary diagram and derivation.
- 16.Draw a phase diagram for liquid helium and explain the importance of lemda line?
- 17.What are liquids He I and He II? Discuss the important properties of liquids He II?
- 18.State and explain Nernst heat theorem. State its various important statements?
- 19.What do you understand by unattainability of absolute zero temperature?

UNIT-IV

1. What is thermodynamic Probability? Write the relation between entropy and thermodynamic probability?
2. What do you mean by phase space and phase point?
3. Differentiate between Fermi Dirac and Bose Einstein statistics?
4. Determine the velocity component for which probability is half of its maximum probability?
5. Describe Planck law of radiation from Bose-Einstein distribution law and Obtain Wien's displacement law from it?
6. What is dwarf star?
7. How the dwarf star form?
8. What is Chandrasekhar mass limit?
9. Explain thermionic emission?
10. Explain fermi electron gas model for metal. Also explain electronic contribution to calculate in specific heat.