Q. P. Code: 16528

(3 HOURS) (MAX. MARKS : 80)

Note:

1. Question No. 1 is compulsory.
2. Attempt any three questions out of remaining five questions.
3. Figures to right indicate full marks.

Q.1

a. Starting from fundamentals, derive a mathematical expression for first law of thermodynamics for a steady state flow process. 05

b. Differentiate between (i) State function and Path Function (ii) Reversible process and irreversible process 10

c. Define (i) Standard heat of formation (ii) Standard heat of reaction 05

Q.2 a. Derive an equation for the coefficient of performance of Carnot refrigeration cycle. 10

b. Explain cubic equation of state. And derive expressions of constants a and b of Vander Waal equation of state in terms of critical properties of substance. 10

Q.3 a. Explain various types of thermodynamic diagrams in brief. 10

b. A reversible heat engine A absorbs energy from reservoir at T1 and rejects energy at reservoir T2. A second reversible engine B absorbs the same amount of energy as rejected by engine A from the reservoir at T2 and rejects the energy to the reservoir at T3. What is the relationship between T1, T2 and T3 if: 10

(i) The efficiency of engine A and B are same.
(ii) The work delivered by engines are same.

Q.4 a. Derive the expression for change in entropy when an ideal gas changes its state from (P1, V1, T1) to (P2, V2, T2). 10

b. One mole of an ideal gas with Cp = (7/2) R and Cv = (5/2) R expands from P1 = 8 bar and T1 = 600 K to P2 = 1 bar by each of following paths: 10

(i) Constant Volume
(ii) Constant Pressure
(iii) Adiabetically

Assuming mechanical reversibility, calculate Q, W, ΔH and ΔU for each process where R = 8.314 kJ/kmol.K

Q.5 a. State various laws of thermodynamics and explain importance of each law. 10

b. Discuss Joule Thomson expansion of liquefaction process. 10

Q.6 a. Write a short note on (i) Internal energy (ii) Heat engine and thermal efficiency of heat engine (iii) Heat pump and COP of pump (iv) Intensive and extensive properties 20