S.E- IV Sem- Chem.

Chemical Engineering Thermodynamics- I

(31)

CHEM/IV/CBGS/CET-1

Q.P. Code : 3633

(3 Hours) **[Total Marks : 100**

N.B.: (1) Question No. 1 is compulsory.
(2) Attempt any **Three** of the remaining questions.
(3) Each question carries **Equal** Marks.

1. Solve any Four of the following.

(a) Three moles of nibgen at 30°C contained in a rigid vessel, its heated to 250°C. How much heat us required to do this, it vessel weights 100 kg and has a capacity of 0.5 $\frac{KJ}{kg^0C}$, how much heat is required? For nitrogen C_v=20.8 J/mol°C $_p$=29.1 J/mol°C. **5**

(b) Give statement of first law of thermodynamics and its mathematical form when applied to different processes. **5**

(c) A carnot engine operating between 800°C and 25°C is used to run a carnot refrigerator operating between -20°C and 25°C. It the engine absorbs 10 KJ/s from the reservoir at 800°C, determine the capacity of the refrigerator. **5**

(d) Define fugacity and fugacity coefficient. **5**

(e) What is a difference between state function and path function. **5**

2. One kmol of an ideal gas at 100 kPa and 300K undergoes the following reversible changes. **20**

(i) Compressed adiabatically to 500 kPa.
(ii) Heated at constant pressure to 800 K.
(iii) Expanded adiabatically to 210 kPa.
(iv) Cooled at constant volume to 300 K.
(v) Expanded isothermally to 100 kPa.

Find ΔH, Q, ΔU & W for the individual stage and also for the entire cycle.
Also find the thermal efficiency of the process.
Cp = 29.099 kJ/kmol k, Cv = 20.785 kJ/kmol K.

3. (a) Find the volume of n-pentane at 500 K and 20 bar for the following cases: **10**
(i) As an ideal gas.
(ii) As Van der waals gas.
Tc = 469.6 K, Pc = 33.7 bar

(b) For an adiabatic process prove that **10**

$$W = \frac{P_1V_1 - P_2V_2}{\gamma - 1}$$

27/5/15

(2)

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4. (a) Find the compressibility foctor at the critical point for a gas obeying vender waal equation of state. 10

$$\left(z+\frac{27}{64}\frac{Pr}{ZTr^2}\right)\left(1-\frac{Pr}{8ZTr}\right)=1$$

(b) A vessel is divided into two parts by a partition, on one side 4 kmol of nitrogen gas at 80°C and 40 bar and on the other side 2 kmol of argon at 120°C and 20 bar are kept. If the partition is removed and the gases are mixed adiabatically, what is the change in entropy? Assume N_2 as an ideal gas. Cp = 5/2 R, Cv = 3/2R. 10

5. (a) Explain the concept of exergy and get the expression to calculate exergy loss when system changes its state. 10

(b) Calculate the enthalpy and entropy departure for n-octance vapor at 427.85 K and 0.215 MPa, using the generalized Redlich-kwong equation of state a = 4.426 $m^6Pa\ Mol^2$ and b = $164.3x10^{-6}m^3/mol$; Z = 0.9308, $B=9.9306x10^{-3}$. 10

6. (a) Derive Maxwells equations. 10

(b) Write note on: 10
(i) Clauses Inequality.
(ii) Joule Thompson Coefficient.