

B.FTBE 3RD YEAR 1ST SEM SUPPLEMENTARY EXAM-2017

CHEMICAL ENGG.THERMODYNAMICS Time: Three Hours Full Marks: 100

Use Separate Answer Scripts for Part I and Part II

Part I (Marks-50)

Question No.1 is Compulsory and answer any two questions from rest

- 1. a) Find the expression of ΔU, ΔH, q and w for an isochoric process. 5
- b) Prove that the P-V diagram for adiabatic process is steeper than the isothermal process. 5
- 2. Prove that for a process  $PV^n=C$  work done  $w_{1-2} = (P_2V_2 - P_1V_1)/(1-n)$ .

A gas in a piston-cylinder assembly undergoes an expansion process from an initial pressure of 5 bar and initial volume of 1.0 m<sup>3</sup> to a final volume of 2.0 m<sup>3</sup>. During the expansion process the relationship between pressure and volume is given by  $PV^n=Constant$ . Determine the work obtained if  $n=2.0$  and  $n=0$  10+5+5=20

3. Air at 1 bar and 298.15K is compressed to 5 bar and 298.15K by a mechanically reversible process: Cooling at constant pressure followed by heating at constant volume. Draw the P-V diagram and calculate the heat and work requirements, ΔU and ΔH of air for each path.  $C_v=20.78$ ,  $C_p=29.10$  J/mol-K. Assume for air  $PV/T$  is a constant. At 298.15K and 1 bar molar volume of air is 0.02479 m<sup>3</sup>/mol. 20

- 4. a) Prove that for an isentropic process  $T_2/T_1 = (P_2/P_1)^{(\gamma-1)/\gamma}$
- b) Methane gas at 550K and 5 bar undergoes a reversible adiabatic expansion to 1 bar. Assuming methane to be an ideal gas at these conditions determines the final temperature provided that γ for methane is 1.3.
- c) Prove that the triple point of water is invariant. 7+8+5=20

5. What are the assumptions of Raoult's law for VLE. What are the limitations of Raoult's law. What is bubble point and Dew point?

Imagine a subcooled mixture of 60 mol% acetonitrile and 40 mol% nitromethane existing in a piston/cylinder arrangement at 348.15K and 42kPa pressure. In a P-X-Y diagram show how the system can be represented? In the figure point out the bubble point and dew point. 3+3+4+10=20

**EX/ FTBE/ T / 311 /2017 (S)**

**B.FTBE. 3<sup>RD</sup> YEAR ( 1<sup>ST</sup> SEM.) SUPPLEMENTARY EXAMS, 2017**

**CHEMICAL ENGINEERING THERMODYNAMICS**

Time: Three hours

Full Marks: 100

Use separate Answer Script for each Part

**PART-I I( 50 Marks )**

**( Answer Any Four Questions. All Questions carry equal marks )**

1. a.) What is the concept of the Absolute temperature in thermodynamics? ( 4 )  
b.) What is the importance of Gibb's potential in understanding a process of thermodynamics? ( 4 )  
c.) Discuss the Zeroth Law and First Law of thermodynamics for ideal and non-ideal systems. ( 8 2/3 )
2. a.) With a suitable example, explain what do you mean by Entropy in a thermodynamic process? ( 6 )  
b.) Discuss the concept of Heat Pump and its application in thermodynamics. ( 10 2/3 )
3. Discuss what do mean by Carnot Cycle and Carnot Engine to determine heat input in a Carnot engine operating between 300 deg centigrade and 20 deg centigrade. ( 16 2/3 )
4. Discuss the application of P-V and T-s diagrams for determining thermodynamic equations relating to heat driven Motion Machines. ( 16 2/3 )
5. With a suitable diagram, discuss the design principle of gas turbine including the applications of Otto Cycle and Diesel Cycle for determining its efficiency. ( 16 2/3 )
6. Write short notes on ( Any Four ):
  - a.) Energy and the threshold value.
  - b.) Joule-Thomson effect
  - c.) The compressor adds energy to the *refrigerant*
  - d.)  $C_p - C_v = R$
  - e.) Van der Wall equation.