B. TECH. SEM - III (CHEMICAL ENGG.) 2014 COURSE) (CBCS)
: SUMMER - 2018
SUBJECT : CHEMICAL ENGINEERING THERMODYNAMICS – I

Day : **Monday** | **S-2018-2224** | Time : **02.30 PM TO 05.30 PM**
Date : **21/05/2018** | Max. Marks : 60

N.B.:

1) All questions are **COMPULSORY**.
2) Figures to the right indicate **FULL** marks.
3) Use of steam tables / mollier diagram is **ALLOWED**.
4) Use of non-programmable **CALCULATOR** is allowed.
5) Assume suitable data if **NECESSARY**.

Q.1 **a)** Obtain an equation for the work of a reversible, isothermal compression of 1 mol of a gas in a piston – cylinder assembly if the molar volume of the gas is given by following equation: **[06]**

$$V = \frac{RT}{P} + b$$

where b and R are positive constants.

b) State first law of thermodynamics and derive the following equation for closed system: $\Delta U = Q \pm W$. **[04]**

OR

Q.1 Water is flowing in a straight horizontal insulated pipe of 25 mm id. There is no device present for adding or removing energy as work. The upstream velocity is 10 m/s. The water flows in a section where the diameter is suddenly increased: **[10]**

i) What is the change in enthalpy if the downstream diameter is 50 mm?
ii) What is the maximum enthalpy change for a sudden enlargement in pipe?

Q.2 **a)** Define heat engine. How Carnot engine is different from heat engine? **[06]**

b) Determine the change in entropy when 2 kg of a gas at 277 K is heated at constant volume to a temperature of 368 K. Take C_V = 1.42 kJ/kg K. **[04]**

OR

Q.2 Derive an expression for ideal gas temperature. Also show that ideal gas temperature and thermodynamic temperature are identical. **[10]**

Q.3 **a)** What is compressibility factor? Write the virial equations in terms of compressibility factor. **[04]**

b) Derive an expression for work done in an adiabatic process in terms of pressure ratio. **[06]**

OR

P.T.O.

Q.3 Obtain the equations for ΔU, ΔH, W and Q for following processes of an ideal gas: **[10]**

i) Constant pressure process
ii) Constant volume process
iii) Isothermal process

Q.4 Obtain the Clapeyron equation from Maxwell's relations. What are the assumptions involved in the derivation of Clausius-Clapeyron equation from Clapeyron equation? **[10]**

OR

Q.4 a) Derive fundamental property relationships for a homogeneous fluid of constant composition. **[06]**

b) Define Helmholtz free energy and Gibbs free energy with physical significance. **[04]**

Q.5 Define liquefaction of gases. What are different processes for the liquefaction of gases? Explain any one in detail. **[10]**

OR

Q.5 Explain the concept of Carnot refrigerator. What are practical limitations of Carnot refrigeration cycle and how these are overcome in vapor compression cycle? **[10]**

Q.6 a) Derive an expression for fugacity of pure substance using compressibility factor. **[06]**

b) Elaborate the terms: **[04]**
i) Ideal gas mixture
ii) Ideal solution

OR

Q.6 a) Define the terms: **[06]**
i) Partial molar property
ii) Residual property
iii) Excess property
iv) Chemical potential

b) Define fugacity and explain the effect of temperature and pressure in fugacity. **[04]**

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