B. Tech. Sem - III (Chemical Engg.) 2014 COURSE) (CBCS) :
SUMMER - 2019
SUBJECT: CHEMICAL ENGINEERING THERMODYNAMICS – I

Day: Thursday
Date: 09/05/2019

S-2019-2545

Time: 02.30 PM TO 05.30 PM
Max Marks: 60

N.B:.

1) All questions are **COMPULSORY**.
2) Figures to the right indicate **FULL** marks.
3) Draw neat and labeled diagram **WHEREVER** necessary.
4) Use of non-programmable calculator is **ALLOWED**.
5) Assume suitable data, if necessary.

Q.1 Enumerate following thermodynamic terms: **(10)**
i) Intensive and extensive properties
ii) State and path functions

OR

Q.1 One kilogram of air is heated reversibly at constant pressure from an initial state of 300 K and 1 bar until its volume triples. Calculate W, Q, Δ U, and ΔH for the process. Assume that air obeys relation (PV/T)= 83.14 (bar cm^3/mol K) and C_P = 29 J/mole K **(10)**

Q.2 A particular power plant operates with a heat source reservoir at 350°C and a heat sink reservoir at 30°C. It has a thermal efficiency equal to 55 % of the Carnot engine thermal efficiency at same temperatures. **(10)**
a) What is the thermal efficiency of plant?
b) To what temperature must the heat source reservoir be raised to increase thermal efficiency of the plant to 35%. Again efficiency is 55% of the Carnot engine value

OR

Q.2 What is entropy? Enumerate mathematical statement of second law of thermodynamics **(10)**

Q.3 Derive the following expression for reversible adiabatic process: **(10)**

$$\ln\frac{T_2}{T_1} = -(\gamma - 1)\ln\frac{V_2}{V_1}$$

OR

Q.3 State two parameter theorem of corresponding states. Enumerate significance of acentric factor with respect to three parameter theorem of corresponding states. **(10)**

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Q.4 Derive the following Maxwell relationship: **(10)**

$$\left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial P}{\partial S}\right)_V$$

$$\left(\frac{\partial V}{\partial T}\right)_P = -\left(\frac{\partial S}{\partial P}\right)_T$$

OR

Q.4 Derive following expression: **(10)**

$$dH = C_P dT + \left[V - T\left(\frac{\partial V}{\partial T}\right)_P\right] dP$$

Q.5 What is liquefaction process? Enumerate Claude liquefaction process with neat sketch. **(10)**

OR

Q.5 Differentiate between refrigeration and liquefaction. Enumerate any one refrigeration cycle **(10)**

Q.6 What is Gibbs theorem for partial molar property? Derive following expression: **(10)**

$$S^{ig} = \sum x_i S_i^{ig} - R\sum x_i \ln x_i$$

OR

Q.6 Derive following expression: **(10)**

$$\left(\frac{\partial \ln \Phi_i}{\partial P}\right)_{T,x} = \left(\frac{\overline{V}_i^{\,R}}{RT}\right)$$

$$\left(\frac{\partial \ln \Phi_i}{\partial T}\right)_{P,x} = -\left(\frac{\overline{H}_i^{\,R}}{RT^2}\right)$$

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