SE. sem-TV. (chem) - CBG1S.

CET - I

Chemical Engg. Thermodynmics - I

QP Code: NP-19773

[Total Marks: 80']

N.B.:

- Question No. 1 is compulsory.
- Attempt any three questions out of remaining five questions.
- Figures to the right indicate full marks.
- Assume suitable data if needed and justify the same.
- What do you mean by a cyclic process? State & explain the first law of thermodynamics for a cyclic process.
 - (b) How is entropy change in an irreverrible process determined?
 - What is the principle of coresponding states?
 - Define fugacity & fugacity coefficient show that the fugacity & pressure are identical for ideal gas.
- One kmol of an ideal gas at 298K and 1 bar is subjected to the following process:
 - Compressed adiabatically to 10 bar pressure
 - Heated at constant pressure to 623K
 - Expanded at constant temperature to 1 bar
 - Cooled at constant pressure to 298K

Calculate Q, W, AU, AH & AS for each step and for the entire path, sketch the process on PSV diagram.

Data:

$$Cp = 29.170 \frac{KJ}{\text{Emol.k}}$$

$$Cv = 20.856 \frac{KJ}{kmol.k}$$

- Dieterici equation of state is given by 3.

Find the value of a and b in terms of Pc and To

Find motor volume and compressibility factor for methane at 100°C and 10 bar (b) pressure for the gas which obeys Dieterici equation of state. Data:

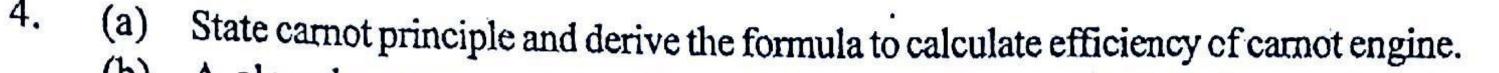
$$Tc = 190.6 K$$

$$Pc = 46 \text{ bar}$$

10

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10

10

(b) A closed system contains 5 kg of air at 500 Kpa and 800 K. Determine the availability of system. The surrounding is at 100 kpa and 303 K.

Data:

Cp = 1.00 KJ/kg.k

Cv = 0.718 KJ/kg.k

 $R = 0.287 \, \text{KJ/kg.k}$

5. (a) Derive the relations to estimate the residual enthalpy and residual entropy for a fluid using the Redlich K wong Soave equation of state.

Redlich Kwong Soave equation of state is given by:

$$P = \frac{RT}{V - b} - \frac{aa}{V(V + b)}$$

(b) Using vander waals equation find Joule-Thomson inversion temperature for Nitrogen gas at 10 MPa.

a = 136.60 kPa (m³/kmcl)²

 $a = 136.69 \text{ kPa} (\text{m}^3/\text{kmol})^2$ $b = 38.64 \times 10^{-3} \text{ m}^3/\text{kmol}$

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(a) Application of first law of thermodynamics to reactive processes

(b) Compressibility factor chart

(c) Clausius inequality

(d) Exergy

(e) Helmholtz energy and Gibbs energy

(f) Mollier diagram.