SE-SEM III

Q. P. Code: 39146

CBCGS

CHEM - CET - I

Time: 3 Hours

Total Marks: 80

N.B.:

(i) Question No.1. is compulsory.
(ii) Attempt any three questions out of remaining five questions.
(iii) Assume suitable data and justify the same.
(iv) Figures to the right indicate full marks.

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BL-09

1. (a) Distinguish between path function and point functions by giving 2 05 examples of each.

(b) Give the Kelvin-Plank statement and the Clausius statement of the second law of thermodynamics. 05

(c) Define and explain exergy. 05

(d) Explain T-S diagram. What is its application? 05

2. One kmole of an ideal gas at 298 K and 1 bar is subjected to the following process: 20

(i) Compressed adiabatically to 10 bar pressure
(ii) Heated at constant pressure to 623 K
(iii) Expanded at constant temperature to 1 bar
(iv) Cooled at constant pressure to 298 K

Calculate Q, W, ΔU, ΔH and ΔS for each step and for the entire path. Sketch the process on P-V diagram.

Data:

$C_p = 29.170$ kJ/kmol.K
$C_v = 20.856$ kJ/kmol.K

3. (a) Derive the relations to estimate the residual enthalpy and residual entropy for a fluid using the van der Waals equation of state. 10

(b) Calculate the compressibility factor & molar volume for methanol vapor at 500 K & 10 bar by using pressure explicit form and volume explicit form of Virial Equation of State. 10

Data:

$B = -2.19 \times 10^{-4}$ m^3/mol & $C = -1.73 \times 10^{-8}$ m^6/mol^2 for methanol.

4. (a) Derive Maxwell Relations. What are its significance? 10

(b) A reversible heat engine operates with three reservoirs at 300 K, 400 K and 1200 K. It absorbs 1200kJ energy as heat from the reservoir at 1200 K and delivers 400 kJ work. Determine the heat interaction with other two reservoirs. 10

5. (a) A mass of water at temperature T_1 is adiabatically mixed with equal mass of water at temperature T_2, show that the entropy change of the universe is, , $= 2mC_p ln \frac{T_1+T_2}{2\sqrt{T1T2}}$ 10

And also show that, Maximum work done= $mC_p\left(\sqrt{T_1}-\sqrt{T_2}\right)^2$

(b) Using the Van der waals equation, find Joule Thomson inversion temperature of nitrogen at 5 MPa, and 10 MPa. $a = 136.69\ kPa\left(\frac{m^3}{kPa}\right)^2$, $b = 38.64 \times 10^{-3}\frac{m^3}{kmol}$, $R = 8.314\ \frac{kJ}{kmol-K}$ 10

6. Write short notes on any four of the following: 20

(i) Polytropic process
(ii) Fugacity and fugacity coefficient
(iii)Reduced equation of state
(iv)Carnot cycle
(v) Gibbs energy

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