05/2016 S.E -IV Se... Chem

THAKUR RAMNARAYAN ENGINEERING COLLEGE
25 ...
BANDRA, MUMBAI-50.

25/5/16

SE/IV/CBGS/Chem./CET-I

**Q. P. Code : 573100**

Chemical Engineering Thermodynamics - I (31)

**(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

**Q 1** Explain any Four

(a) Fugacity and Fugacity Coefficient

(b) Explain T-S diagram — 05

(c) What do you understand by an equation of state? Write down three equations of state. — 05

(d) Define Helmholtz Energy and Gibbs Energy — 05

(e) Explain heat engine, heat pump and how the performance of heat engine and heat pump are measured — 05

**Q 2** (a) Determine Q ,W, ΔU and ΔH for each step of a process in which argon is compressed isothermally at 500 K, 0.2 to 3 Mpa , is cooled isobarically to 300 K, is expanded adiabatically to 1.0 Mpa , is expanded isothermally to its initial value and is then heated isobarically to 500 K. Sketch all processes on a P-V diagram. — 12

$Cp = 3.5R$ KJ/ Kmol,K $Cv = 2.5R$ KJ/Kmol ,K $R = 8.314$ KJ/Kmol K

(b) Derive Maxwell relations. — (8

**Q 3** (a) It is required to freeze 1 kg of water at 273 K by means of a refrigeration machine which operates in the surrounding at 300 K. The latent heat of fusion of ice at 273 K is 334. 11 KJ/Kg. Determine — 10

a) The minimum amount of work required

b) Heat given up to the surroundings.

(b) Berthelot equation of state is given by — 10

$$(P + \frac{a}{Tv2})(v - b) = RT$$

Find the value of a and b in terms of $P_c$ and $T_c$

**Q4** (a) Find the volume of N-Pentane at 500 K and 20 bar for a gas obey Redlich Kwong equation of state. $Tc = 469.6$ K $Pc = 33.7$ bar — 10

(b) A steel casting at a temperature 725 K and weighing 35 Kg is quenched in 150 kg oil at 275 K. If there are no heat losses. Determine the change in entropy. — 10

Cp of steel = 0.88 KJ/kg K Cp of oil = 2.5 KJ/Kg K

**TURN OVER**

25/05/2016

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Q 5 (a) Prove that ratio of heat capacity $\frac{Cp}{Cv} = (\frac{dv}{dp})_T (\frac{dp}{dv})_v$

(b) Prove that internal energy is a function of only temperature, in case of an ideal gas.

(c) Derive the relations to estimate the residual enthalpy and residual entropy for a gas obeying vander Waals equation of state.

Q 6 (a) Chlorine gas faliow redlich kwong equation of state with following constants

$a = 8671.28$ Kpa $(m^3/kmol)\ K^{½}$

$b = 0.02595\ m^3/kmol$

Find enthalpy and entropy departure at pressure 155 bar and temperature 520 K consider $z = 0.7723$

(b) Derive an expression for Joule Thomson Coefficient for vander waal gas and find the relation for inversion temperature.

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