

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

- Q1 Explain any Four: 20
- (a) First law of thermodynamics for flow processes
  - (b) Explain heat engine, heat pump and refrigerator
  - (c) Discuss concept of entropy
  - (d) Explain Compressibility factor
  - (e) Fugacity and fugacity coefficient
- Q2 (a) One kmol of an ideal gas at 298K & 150Kpa is compressed ideabatically to a temperature 363.2K and cooled isobarically to 298K and finally expanded isothermally to its original pressure of 150Kpa. Find Q,  $\Delta U$ ,  $\Delta H$  for the cycle. 10  
Data:  $C_p = 29.17$  KJ/Kmole K and  $C_v = 20.857$  KJ/Kmole K
- (b) Explain Carnot cycle with its principle. 10
- Q3 (a) In Heat exchanger cold air is heated from 293K to 353K by means of hot air which enters the exchanger at 423K. the molar flowrates of both streams are equal. The specific heat of air 29.3 KJ/KmolK. Calculate entropy change of both air streams and total entropy change. 10
- (b) Write a note on Exergy. 10
- Q4 (a) An adiabatic nozzle receives dry saturated steam at 0.6 MPa(6 bar) with negligible velocity. The steam leaves the nozzle as dry saturated steam at 0.15 MPa (1.5 bar). Calculate the exit velocity of the steam. 10  
Data: saturated steam at 6 bar  $H_v = 2756.80$  KJ/Kg  
saturated steam at 1.5 bar  $H_v = 2693.60$  KJ/Kg
- (b) Explain T-S diagram with its applications 10
- Q5 (a) Determine the molar volume of methane at 600 bar and 300K by using 10
- i) Ideal gas equation
  - ii) The Redlich Kwong equation the critical temperature and pressure are 191.1K and 46.4 bar respectively.
- (b) Derive the equation for Enthalpy and Entropy departure for a gas obeying Van der Waals equation of state. 10
- Q6 (a) Show that the fugacity of a Vander waals gas equation is given by 10  
$$\ln f = \frac{b}{v-b} - \frac{2a}{RTv} + \ln\left(\frac{RT}{v-b}\right)$$
- (b) Derive Maxwell Equation. 10

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