Code: 9D17101

M.Tech I Semester Supplementary Examinations August 2016

ADVANCED THERMODYNAMICS

(Refrigeration & Air Conditioning)

(For students admitted in 2012, 2013, 2014 & 2015 only)

Time: 3 hours Max. Marks: 60

Answer any FIVE questions

All questions carry equal marks

*****

1 A piston-cylinder device contains 0.15 kg of air initially at 2 MPa and 350^{0}C. The air is first expanded isothermally to 500 kPa, then compressed polytropically with a polytropic exponent of 1.2 to the initial pressure and finally compressed at the constant pressure to the initial state. Determine the boundary work for each process and the net work of the cycle.

2 (a) Explain the equation of state for real gases and suggest a suitable method for calculation of constants in the Vander Waal's equation. Describe briefly about generalized compressibility charts along with its importance.

(b) Determine the pressure of saturated steam at 40^{0}C if at 35^{0}C the pressure is 5.628 kPa, the enthalpy of vaporization is 2418.6 kJ/kg and the specific volume is 25.22 m^3/kg. The enthalpy of vaporization is essentially constant over this temperature range.

3 A rigid tank contains 2 kmol of N_2 and 6 kmol of CO_2 gases at 300 K and 15 MPa. Estimate the volume of the tank on the basis of:

(a) The ideal-gas equation of state.
(b) Kay's rule.
(c) Compressibility factors and Amagat's law.
(d) Compressibility factors and Dalton's law.

4 Determine the Gibbs energy for water at 25^{0}C and 1 bar. Under those conditions, also determine the change in the Gibbs energy when $H_2O(1)$ is formed from its elements and the Gibbs energies of formation for $H_2O(1)$ and $H_2O(g)$.

5 Five kmole of CO, three kmole of O_2 and two kmole of CO_2 are fully mixed when they enter a combustor at 3000 K and 1 bar. The products leave the combustor at the same temperature and pressure at equilibrium. Determine the optimum work.

6 Draw and explain the Rankine cycle with reheat and compare the Rankine and Carnot cycles with T-S diagram.

7 An air standard Otto cycle is to be designed according to the following specifications:
Pressure at the start of the compression process = 101 kPa.
Temperature at the start of compression process = 300 K.
Compression ratio = 8.
Maximum pressure in the cycle = 8.0 MPa.
Find:

(a) The network output per unit mass of air.
(b) Cycle efficiency.
(c) MEP.

8 Describe with neat sketch Fuel Cell Power Systems and Thermoelectric Power Conversion.

*****