4/12/13

B.E. / B.Tech (FT) DEGREE END SEMESTER EXAMINATIONS, NOV / DEC 2013

MECHANICAL ENGINEERING BRANCH

Regulation : 2004/2008 SEMESTER : 3

ME271 / ME9202 ENGINEERING THERMODYNAMICS

INSTRUCTIONS

Use of Standard Steam Tables permitted

Assume any data required suitably with proper justification

Answer All Questions

Time : 3 Hrs **Max Marks : 100**

PART A (10 X 2 = 20 Mark)

1. List out various modes of work.
2. What is the relation between the specific heat at constant volume and that at constant pressure?
3. What is perpetual motion machine of second kind?
4. What are the features of thermodynamic temperature scale?
5. What is meant by dead state?
6. Why is entropy generated during a process?
7. What is latent heat?
8. How does triple point differ from critical point?
9. What is the quality of superheated steam specified?
10. What is adiabatic saturation process?

PART B (5 x 16=80 Mark)

11) (i) Derive the expression for the displacement work and show that it is a path function. (4+4)

(ii) It is desired to compress 10 kg of gas from 1.5 m^3 to 0.3 m^3 at a constant pressure of 15 bar. During this compression process, the temperature rises from 20 to 150°C and increase in internal energy is 3250 kJ. Calculate the work done, heat interaction and change in enthalpy during the process. Also work out the average value of specific heat at constant pressure. (10)

12) a) (i) What will be the efficiency of all reversible engines operating between the same temperature limits? Justify (6)

(ii) If three Carnot Engines of same efficiency connected in series such that the 1200 K reservoir supplies 2400 kJ of heat and 150 K reservoir receives 300 kJ of heat, find out the intermediate temperatures, the efficiency, work outputs. (10)

(OR)

b) (i) Explain why the slope of constant volume line is more than the slope of constant pressure line on T–S diagram (6)

(ii) Air at 293 K and 105 kPa occupies 25 litres. It is heated at constant volume until the pressure is 450 kPa, and then cooled at constant pressure back to original temperature. (a) Sketch the process on p-v and T-s diagram, (b) calculate the net heat transfer and net entropy change. (10)

13) a) (i) Derive the expression for the availability function of an open system (6)

(ii) Calculate the total available energy, before and after mixing, when 25 kg of water at 95°C is mixed at constant pressure and temperature with 35 kg of water at 35°C, in the surroundings at 15°C. Also calculate the loss of available energy. Is it reversible or irreversible process? and Why? (10)

(OR)

b) (i) What are Helmholtz function and Gibbs function? (6)

(ii) Air flows through an adiabatic compressor at 2 kg/s. The inlet conditions are 100 kPa and 310 K, and the exit conditions are 700 kPa and 560 K. Consider T_0 to be 298 K. Determine the change of availability and the irreversibility. (10)

14) a) (i) What is meant by melting, evaporation and sublimation? (6)

(ii) A steam boiler initially contains 9 m^3 of water and 1 m^3 of steam at 2 MPa pressure. Heat is added and steam is utilised at constant pressure, till the boiler finally contains 1 m^3 of water and 9 m^3 of steam. Calculate the mass of steam utilised and the required heat supply. (10)

(OR)

b) A steam power plant operates on Rankine cycle between 30 bar and 5 kPa. Determine the steam quality at the turbine exit, the work ratio and cycle efficiency, if it operates on

(i) Simple ideal Rankine cycle (6)

(ii) Reheat Rankine cycle (reheat pressure : 3 bar) (10)

15) a) (i) What is specific humidity? When is it maximum? (6)

(ii) In an air stream of 12000 m^3/h at 25°C dry bulb temperature and 12°C wet bulb temperature, 72 kg/h of saturated steam at 100°C is added. If the whole process takes place at 1 atm pressure, find the specific humidity, specific enthalpy, dry bulb temperature, wet bulb temperature, and relative humidity of the final air. (10)

(OR)

b) (i) Explain the importance of evaporative cooling with suitable examples (6)

(ii) A stream of air at 1atm pressure, 18°C and 40 % relative humidity flowing at 550 m^3/h adiabatically mixes with another stream at 1 atm, 38°C and 60 % relative humidity, flowing at 250 m3/h to form a third stream at 1 atm pressure. Determine the temperature, specific humidity, specific enthalpy and the relative humidity of the mixed stream.(10)