16/11/13

28

Roll No. | | | | | | | | | | |

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

MECHANICAL ENGINEERING

III SEMESTER

ME8301 ENGINEERING THERMODYNAMICS

(Regulation 2012)

INSTRUCTIONS

(Use of Standard Steam Tables, Mollier, Compressibility and Psychrometric Charts permitted
Assume any data required suitably with proper justification

Time : 3 Hours Answer All Questions Max Marks : 100

PART A (10 X 2 = 20 Mark)

1. What is the thermodynamic definition of work?
2. Compare steady flow system with unsteady flow system with examples.
3. If the COP of reversible heat pump is 4, what is the COP of the reversible refrigerator operating between the same temperature limits?
4. What is meant by Helmholtz and Gibbs function?
5. Find the condition 20 kg of steam in 10 m^3 of vessel at 5 bar pressure.
6. What are the merits and demerits of regenerative Rankine cycle.
7. State the principle of corresponding states.
8. What is the significance of Energy equation for real gases?
9. Air contains 23% oxygen and 77% nitrogen by weight. What is its molecular mass?
10. Plot adiabatic saturation process on Psychrometric chart and show how the relative humidity and humidity ratio changes.

PART B (5 x 16=80 Mark)

11) (i) State the first law of thermodynamics for a process and show that internal energy is a point function. (6)

b) A closed and rigid tank contains 0.5 kg of hydrogen (Molecular Mass : 2 kg/kmol), which is heated until the gas pressure is doubled. The initial condition of the gas is 2 bar and 35°C. Calculate the heat transfer, work transfer, change in internal energy and change in internal entropy. (10)

12) a) (i) Derive the expression for the entropy change in terms of temperatures and pressures. (6)

(ii) An engine working between 150°C and 32°C (the atm. temperature) drives a refrigerator which, in turn, produces a cooling at -25°C. Assuming both devices to be reversible, draw the layout to show the energy transfers and calculate the ratio of heat taken at 150°C to the cooling produced (10)

(OR)

b) (i) Differentiate between High Grade Energy & Low Grade Energy and Available Energy & Unavailable Energy. (6)

(ii) One kg of water at 273 K is brought into contact with a heat reservoir at 373 K. when the water has reached 373 K. (i) Find the entropy change of the water, of the heat reservoir, and of the universe. (ii) If water is heated from 273 K to 373 K by first bringing it in contact with a reservoir at 323 K and then with a reservoir at 373 K what will be the entropy change of the universe. (iii) Explain how water might be heated from 273 to 373 k with almost no change in the entropy of the universe. (10)

13) a) (i) Briefly explain the formation of steam from ice at constant pressure with the help of p – v and T – s diagram. (6)

(ii) Steam enters the throttling calorimeter at 20 bar pressure and the pressure and temperature after the throttling valve is 1 bar 125°C, respectively. Plot the process on h – s diagram and calculate the dryness fraction of the steam at 20 bar pressure. Also calculate the change in entropy and enthalpy. (10)

(OR)

b) (i) Draw the combined cycle on T – s diagram and label the processes? (6)

(ii) In a regenerative Rankine cycle, 100 kg/s of steam enters the steam turbine at 30 bar and 400°C and expands in a steam turbine to a condenser pressure of 0.5 bar. If steam is extracted at 3 bar for open feed water heating such that the boiler feed water reaches the saturation temperature in the heater, calculate the rate of steam extraction, the specific steam consumption, the network per kg, the power output and the thermal efficiency. (10)

14) a) (i) Present the comparison of ideal gas and real gas, with suitable reasons. (6)

(ii) Bring out the importance of reduced properties and explain the use of compressibility chart (10).

(OR)

b) (i) Derive the Maxwell's relations. (6)

(ii) Derive the relationship for the difference between the specific heat at constant pressure and that at constant volume and deduce its value for an ideal gas.(10)

15) a) (i) State and prove the Dalton's law of partial pressure and establish the relationship between the mole and mass fractions. (6)

(ii) A rigid tank of 5 m^3 capacity contains a gas mixture comprising 3 kg of oxygen, 4 kg of nitrogen and 5 kg of CO_2 at 290K.If it is heated to 350 K, calculate the heat transfer and change in enthalpy and entropy. (10)

(OR)

b) (i) Plot the sensible heating process on psychrometric chart and explain the changes in relative humidity, enthalpy, wet bulb and dry bulb temperatures. (6)

(ii) If the air stream of 1800 m^3/h at 35°C and relative humidity of 50% is mixed with another air stream of 2100 m^3/h of air at 20°C and relative humidity of 100% at 1 atm pressure, find the specific humidity, specific enthalpy, dry bulb temperature, wet bulb temperature, and relative humidity of the stream of mixture. (10)