C 80685 (Pages : 2) Name.....

Reg. No.....

FOURTH SEMESTER B.TECH. (ENGINEERING) (99 SCHEME) DEGREE EXAMINATION, APRIL 2015

ME 09 406/PTME 09 405—THERMODYNAMICS

Time : Three Hours Maximum : 70 Marks

Part A

Answer **all** *questions.*

1. Define a thermodynamic system. Classify the following systems as open/closed/isolated system :
   (a) Mixture of ice and water in a metal container ;
   (b) A wind mill ;
   (c) A centrifugal pump ;
   (d) Thermo flask.
2. What is a perpetual motion machine of first kind (PMM1) ? Why it is impossible ?
3. What is meant by availability ?
4. State Dalton's law of partial pressures.
5. Differentiate between relative humidity and specific humidity.

(5 × 2 = 10 marks)

Part B

Answer any **four** *questions.*

1. Define Internal energy. Prove that internal energy is a property of the system.
2. State the Clausius and Kelvin Planck statements of second law of thermodynamics. Why the second law of thermodynamics is called a directional law of nature ?
3. What is meant by reversibility ? State the conditions for reversibility.
4. State the equation of van der Waal's gas and explain the importance of each term. Also bring out the limitations of the equation.
5. Define the terms :
   (a) dry bulb temperature ; (b) wet bulb temperature.
   (c) dew point temperature ; (d) degree of saturation.
6. A sling psychrometer reads 40° C DBT and 36° C WBT. Find the humidity ratio, relative humidity, dew point temperature, specific volume and enthalpy of air using psychrometric chart.

(4 × 5 = 20 marks)

Turn over

Part C

Answer any **four** *questions.*

1. Air at a temperature of 15° C passes through a heat exchanger at a velocity of 30 m/s where its temperature is raised to 800° C. It then enters a turbine with the same velocity of 30 m/s and expands until the temperature falls to 650° C. On leaving the turbine the air is taken at a velocity of 60 m/s to a nozzle where it expands until the temperature has fallen to = 500° If the air flow rate is 2 kg/sec, calculate

   (a) the rate of heat transfer to the air in the heat exchanger ;

   (b) the power output from the turbine assuming no heat loss ; and

   (c) the velocity at the exit of the nozzle assuming no heat loss.

   Take the enthalpy of air as $h = C_p T$ where C_p is the specific heat equal to 1.005 KJ/kg K and T is the temperature.

Or

2. Describe in brief the Steady Flow Energy Equation (SFEE) with assumptions made. Deduce suitable expression applied to a turbine and nozzle.

3. (i) Represent the Carnot cycle on p-V and T-s planes and deduce an expression for the thermal efficiency in-terms of temperatures.

   (8 marks)

   (ii) What are the causes of irreversibility of a process ? (2 marks)

Or

4. 1200 KJ of heat is supplied to an engine from a source of 20° C, the sink temperature is 2° C. Which of the following cycle represents reversible, irreversible and impossible cycle ?

   (a) 275 kJ is rejected to sink ;

   (b) 825 kJ heat is rejected ;

   (c) 350 kJ heat is rejected.

5. Define pure substances. Draw and explain the p-V, p-T, T-s diagrams for pure substance.

Or

6. (a) Write short notes on generalized compressibility chart. (2 marks)

   (b) A gas mixture consists of 12 kg of methane, 5 kg of nitrogen and 3 kg of oxygen. Determine the molecular mass and gas constant of the mixture. If the total pressure is 100 kPa, calculate their partial pressures.

   (8 marks)

7. Derive any two Maxwell's equations in detail.

Or

8. Atmospheric air at 1.0132 bar has a DBT of 32° C and WBT of 26° C. Compute : (a) the partial pressure of water vapour ; (b) the specific humidity ; (c) the dew point temperature ; (d) the relative humidity ; (e) the degree of saturation ; (f) the density of air in the mixture ; (g) the density of vapour in the mixture ; and (h) the enthalpy of the mixture.

[4 × 10 = 40 marks]