Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Third semester B.Tech examinations (S) September 2020

Course Code: ME205

Course Name: THERMODYNAMICS

(Permitted to use Steam tables and Mollier Charts)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any three full questions, each carries 10 marks. Marks

1 a) Explain the Zeroth law of thermodynamics. What is its physical significance? (4)

b) What are intensive and extensive properties of a thermodynamic system? (3)

c) What is a thermocouple? What is its engineering application? (3)

2 a) Explain the concept of continuum with a suitable example. (4)

b) Describe a few situations in which forms of work other than displacement or pdv work appear in systems. (6)

3 a) Apply the first law of thermodynamics to a closed system undergoing a change state and show that energy is a property of the system. (5)

b) If a gas of volume 6000cm^3 and at a pressure of 100KPa is compressed quasi-statically according to pV^2=constant until volume becomes 2000 cm^3, determine the final pressure and work transfer. (5)

4 a) Obtain the mass balance and energy balance equations for a variable flow process. (5)

b) In a Water cooling tower, air enters at a height of 1 m above the ground level and leaves at a height of 7 m. The inlet and outlet velocities are 20 m/s and 30 m/s respectively. Water enters at a height of 8 m and leaves at a height of 0.8 m. The velocity of water at entry and exit are 3 m/s and 1 m/s respectively. Water temperatures are 80°C and 50°C at the entry and exit respectively. Air temperatures are 30°C and 70°C at the entry and exit respectively. The cooling tower is well insulated and a fan of 2.25 kW drives the air through the cooler. Find the amount of air per second required for 1 kg/s of water flow. The values of c_p of air and water are 1.005 and 4.187 kJ/kg K respectively. (5)

PART B

Answer any three full questions, each carries 10 marks.

5 a) Explain at least three different causes of irreversibility associated with a process. (6)

b) State and prove Carnot's theorem. (4)

6 a) An ice-making plant produces ice at atmospheric pressure and at 0°C from (4)

water. The mean temperature of the cooling water circulating through the condenser of the refrigerating machine is 18°C. Evaluate the minimum electrical work in kWh required to produce 1 tonne of ice (The enthalpy of fusion of ice at atmospheric pressure is 333.5 kJ/kg).

b) Derive the expression for maximum work obtainable when heat transfer occurs between a finite body and a thermal energy reservoir. (6)

7 a) What do you mean by "dead state" of a system? (3)

b) Obtain an expression for useful work for a steady flow system which interacts only with the surroundings. (7)

8 a) Explain the following i)P-V-T surface ii) Mollier Charts (5)

b) A rigid closed tank of volume 3 m^3 contains 5 kg of wet steam at a pressure of 200 kPa. The tank is heated until the steam becomes dry saturated. Determine the final pressure and the heat transfer to the tank. (5)

PART C

Answer any four full questions, each carries 10 marks.

9 Explain the following i) Law of corresponding states ii)Compressibility factor iii)Virial expansion iv)Van der Waals equation of state (10)

10 a) Explain Amagat's law of additive volumes for a mixture of ideal gases. (4)

b) A certain mass of sulphur dioxide is contained in a vessel of 0.142 m^3 capacity at a pressure and temperature of 23.1 bar and 18°C respectively. A valve is opened momentarily and the pressure falls immediately to 6.9 bar. Sometimes later the temperature is again 18°C and the pressure is observed to be 9.1 bar. Estimate the value of specific heat ratio. (6)

11 Obtain Maxwell's equations from basic thermodynamic relations. (10)

12 a) Derive Clausius –Clapeyron equation. (5)

b) Explain the following terms i) Enthalpy of formation ii) Heating Values (5)

13 Explain the Joule Kelvin effect and the inversion curve. (10)

14 a) Explain the enthalpy of formation in the chemical combustion process. (5)

b) What do you mean by equivalence ratio for combustion? Write down the balanced combustion equation of CH_4 and with 50% excess air. (5)

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