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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2017

Course Code: ME205

Course Name: THERMODYNAMICS (MA, ME, MP, AN)

Max. Marks: 100 Duration: 3 Hours

PART A

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

1 a) Define property of a system with any two examples. Why thermodynamic properties are taken as coordinates in thermodynamics? (3)

b) Explain free expansion? Why the displacement work is absent in free expansion? (4)

c) List any 6 applications of thermodynamics. (3)

2 a) What is PMM1? Why it is not possible? (3)

b) Define enthalpy. Prove that for ideal gas enthalpy is a function of temperature alone. (3)

c) Explain the working of thermocouple with neat sketch. (4)

3 a) A rigid tank of $2m^3$initially contains air at 100kPa and 25^0C. The tank is connected to a supply line which contains air at 600kPa and 25^0C through a valve. The valve is opened and air is allowed to enter the tank until the pressure in the tank reaches the line pressure at which the valve is closed and the temperature of the air inside the tank at this instant measures 80^0C. Determine (a) the mass of air that has entered the tank and (b) the amount of heat transfer. (6)

b) What is total energy of a system? Prove that total energy is thermodynamic property of a system. (4)

4 a) Derive steady flow energy equation. (5)

b) In an adiabatic gas turbine, air expands at 1200kPa and 500^0C to 100kPa and 150^0C. Air enters the turbine with a velocity of 40m/s through an opening of area $0.2m^2$ and exhausts through a $1m^2$ opening. Determine (a) mass flow rate of air through the turbine and (b) the power produced by the turbine. (5)

PART B

Answer any three full questions, each carries 10 marks.

5 a) Give two statements of second law of thermodynamics and prove its equivalence (5)

b) State and explain principle of increase of entropy. Discuss its physical significance. (5)

6 a) State and prove Clausius inequality. (6)

b) What is meant by (i) exergy (ii) dead state (iii) availability (4)

7 a) State and prove Carnot's theorem. (5)

b) Define dryness fraction. Draw the p-v-T surface of a substance that contracts on freezing. (5)

8 Derive the expression for availability of flow process. (10)

PART C

Answer any four full questions, each carries 10 marks.

9 a) What are reduced properties? State the law of corresponding states? (4)

b) A $0.5m^3$ rigid tank containing Hydrogen at 20^0C and 400kPa is connected by a valve to another $0.5m^3$ rigid tank that holds Hydrogen at 50^0C and 150kPa. Now the valve is opened and the system is allowed to reach thermal equilibrium with the surroundings, which are at 15^0C. Determine the final pressure in the tank and the amount heat transferred to the surrounding. Take γ=1.38 (6)

10 a) The volumetric analysis of mixture of gases is 30 percent Oxygen, 40 per cent Carbon dioxide and 30 percent Nitrogen. The mixture is heated from 20^0C to 200^0C while flowing through a pipe in which the pressure is maintained at 150kPa. Determine the heat transfer to the mixture per unit mass of the mixture. Take C_p values of Oxygen, Carbondioxide and Nitrogen as 0.918, 0.846 and 1.039kJ/kg K. (6)

b) What is virial expansion? Explain the term compressibility factor. (4)

11 a) What is Kay's rule? Give its importance. (4)

b) Explain law of partial pressures and Amagat's law of additive volumes for the mixture of ideal gases. (6)

12 a) Comment on the physical significance of Clasius- clapeyron equation. (4)

b) Define Gibbs and Helmholtz function. Give its significance on chemical reaction. (6)

13 a) What are Maxwell's equations? Also derive TDS equations. (5)

b) Define Joule-Thomson coefficient. What is its significance? Determine its value for an ideal gas. (5)

14 a) Define equivalence ration. What is its significance? (4)

b) Explain (i) enthalpy of combustion and (ii) enthalpy of formation. (6)

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