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Reg. No._____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, JANUARY 2017

ME205: THERMODYNAMICS (AN, MA, ME, MP)

Max. Marks: 100 Duration: 3 Hours

PART A
(Answer any THREE questions)

1. a) Explain thermodynamic equilibrium (3)

   b) What is quasi-static process? What is its characteristic feature? (3)

   c) What is the concept of continuum? How will you define density and pressure using this concept? (4)

2. Write short notes on

   a) Different forms of energy. (3)
   b) System, boundary and surroundings. (4)
   c) Point and path functions. (3)

3. a) Define specific heat and derive it for constant pressure and constant volume. (4)

   b) A turbo compressor delivers 2.33 m^3/s at 0.276 MPa, 43°C which is heated at this pressure to 430°C and finally expanded in a turbine which delivers 1860 kW. During the expansion, there is a heat transfer of 0.09 MJ/s to the surroundings. Calculate the turbine exhaust temperature if changes in kinetic and potential energy are negligible. (6)

4. a) Calculate the internal energy and enthalpy of 1kg of air occupying 0.03m^3 at 3MPa. (4)

   b) Explain Joule's experiment with neat sketches and state first law. (6)

PART B
(Answer any THREE questions)

5. a) State and prove Clausius' theorem (4)
   b) A fluid undergoes a reversible adiabatic compression from 0.5MPa, 0.2m^3 to 0.05m^3 according to the law, $pv^{1.3}$ = constant. Determine the change in enthalpy, internal energy and entropy, and the heat transfer and work transfer during the process. (6)

6. a) Establish the Inequality of Clausius? (5)
   b) Explain entropy principle and its applications? (5)

7. a) What is the critical state? Draw the phase equilibrium diagram on p-v coordinates for a substance which shrinks in volume on melting. (4)

b) Steam initially at 0.3 MPa, 250°C is cooled at constant volume. (a) At what temperature will the steam become saturated vapour? (b) What is quality at 80°C? (c) What is the heat transferred per kg of steam in cooling from250°C to 80°C? (6)

8. a) What is exergy, dead state and triple point? (4)
b) A rigid vessel contains 1 kg of a mixture of saturated water and saturated steam at a pressure of 0.15 MPa. When the mixture is heated, the state passes through the critical point.
Determine
(i) The volume of the vessel.
(ii) The mass of liquid and of vapour in the vessel initially.
(iii) The temperature of the mixture when the pressure has risen to 3 MPa.
(iv) The heat transfer required to produce the final state. (6)

PART C
(Answer any FOUR questions)

9. a) Derive the equations used for computing the entropy change of an ideal gas. (4)
b) Two tanks are connected by a valve. One tank contains 2 kg of CO_2 gas at 77°C and 0.2 bar. The other tank holds 8 kg of the same gas at 27°C and 1.2 bar. The valve is opened and the gases are allowed to mix while receiving energy by heat transfer from the surroundings. The final equilibrium temperature is 42°C. Determine the final equilibrium pressure and heat transfer for the process. (6)

10. a) Explain equation of state and law of corresponding state. (4)
b) Derive law of corresponding state from vanderwaals equation. (6)

11. a) State and explain Amagat's law of partial volumes of a gas mixture. (4)
b) A mass of 0.25 kg of an ideal gas has a pressure of 300 kPa, a temperature of 80°C, and a volume of 0.07 m^3. The gas undergoes an irreversible adiabatic process to a final pressure of 300 kPa and final volume of 0.10m^3, during which work done on gas is 25 kJ. Evaluate the c_p and c_v of the gas and the increase in entropy of the gas. (6)

12. Explain Joule-Thomson coefficient and Inversion curve. (10)

13. a) What is Joule - Kelvin effect? What is inversion temperature? (5)
b) Explain how enthalpy change and entropy change of a gas are estimated from an equation of state. (5)

14. a) Derive Clausiusclapeyron equation. (6)
b) A certain gas has Pc = 0.913 and Vc = 0.653 kJ/kg K. Find the molecular weight and the gas constant R of the gas? (6)

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