

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

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| 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 $pV^2=\text{constant}$ until volume becomes 2000cm^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.*

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| 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 m³ 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 (10)
iii) Virial expansion iv) Van der Waals equation of state
- 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 m³ 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 CH₄ and with 50% excess air. (5)
