

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**THIRD SEMESTER B.TECH DEGREE EXAMINATION(S), MAY 2019**

**Course Code: ME205**  
**Course Name: THERMODYNAMICS**  
**(Steam Tables allowed)**

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 microscopic and macroscopic view points  | (3) |
|   | b) Distinguish between change of state, path and process  | (3) |
|   | c) How will you define density and pressure using the concept of continuum?   | (4) |
| 2 | a) Explain constant volume gas thermometer with a neat diagram  | (3) |
|   | b) Why does free expansion have zero work transfer?   | (3) |
|   | c) Define internal energy. Show that energy a property of a system  | (4) |
| 3 | a) Define specific heat and derive it for constant volume and at constant pressure  | (4) |
|   | b) A gas of 4 kg is contained within the piston cylinder machine. The gas undergoes a process for which $pV^{1.5} = \text{Constant}$ . The initial pressure is 3 bar and the initial volume is $0.1\text{m}^3$ , and the final volume is $0.2\text{m}^3$ . The specific internal energy of the gas decreases by $4.6\text{kJ/kg}$ . There is no significant change in KE and PE. Determine net heat transfer for the process. | (6) |
| 4 | a) How can you relate S.F.E.E with Euler and Bernoulli Equations?   | (5) |
|   | b) A pump steadily delivers water at a volumetric flow rate of $0.05\text{m}^3/\text{s}$ through a pipe of diameter 18 cm located 100 m above the inlet pipe which has a diameter of 15 cm. The pressure is nearly equal to 1 bar at both the inlet and the exit, and the temperature is nearly constant at $20^\circ\text{C}$ throughout. Determine the power required by the pump. Take $g = 9.81\text{ m/s}^2$             | (5) |

**PART B**

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

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|---|--|-----|
| 5 | a) Establish the equivalence of Kelvin – Plank and Clausius statement  | (5) |
|   | b) A heat pump working on the Carnot cycle takes in heat from a reservoir at $5^\circ\text{C}$ and deliver heat to a reservoir at $60^\circ\text{C}$ . The heat pump is driven by a reversible heat engine which takes in heat from a reservoir at $840^\circ\text{C}$ and rejects heat to a reservoir at $60^\circ\text{C}$ . The reversible heat engine also drives a machine that absorbs $30\text{kW}$ . If the heat pump extracts $17\text{kJ/s}$ from $5^\circ\text{C}$ reservoir. Determine (a) rate of | (5) |

- heat supply from the 840°C source and (b) the rate of heat rejection to the 60°C sink.
- 6 a) Establish the Inequality of Clausius (5)  
 b) A fluid undergoes a reversible adiabatic compression from 0.5Mpa, 0.2m<sup>3</sup> to 0.05m<sup>3</sup> according to law,  $p v^{1.3} = \text{constant}$ . Determine the change in enthalpy, internal energy and entropy and the heat transfer and work transfer during the process. (5)
- 7 a) What do you understand by exergy and anergy? (3)  
 b) Derive expression for useful work for a steady flow system which interact only with the surroundings (7)
- 8 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 from 250°C to 80°C? (6)

### PART C

*Answer any four full questions, each carries 10 marks.*

- 9 a) Show that enthalpy of an ideal gas is a function of temperature only (4)  
 b) Express Van der Waals equation of state in the virial form and find the Boyle temperature (6)
- 10 a) Explain different properties of real gas mixtures and the laws associated. (10)
- 11 a) Show that in a diffusion process a gas undergoes a free expansion from the total pressure to the relevant partial pressure. (10)
- 12 a) Derive Maxwell relations from relevant equations of the form  $dz = Mdx + Ndy$ . (10)  
 Also derive Clausius-Clapeyron equation from Maxwell relation.
- 13 a) Explain how enthalpy change and entropy change of a gas are estimated from an equation of state. (10)
- 14 a) Define adiabatic flame temperature. How is it estimated? (5)  
 b) Explain enthalpy of combustion. (5)

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