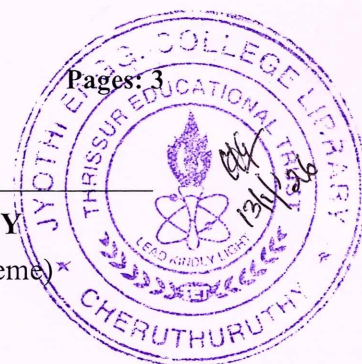


Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S4 (S,FE) Examination January 2026 (2019 Scheme)



Course Code: MRT202

Course Name: THERMODYNAMICS

(Permitted to use Steam Tables and Mollier charts)

Max. Marks: 100

Duration: 3 Hours

PART A

(Answer all questions; each question carries 3 marks)

Marks

- | | | |
|----|---|---|
| 1 | What are the three conditions for thermodynamic equilibrium? | 3 |
| 2 | What you mean by an extensive property. Give an example | 3 |
| 3 | Give the comparison between work and heat. | 3 |
| 4 | Explain work done in the case of free expansion with a suitable example. | 3 |
| 5 | Discuss the concept of the principle of increase in entropy | 3 |
| 6 | Derive the relationship between COP of refrigerator and COP of heat pump. | 3 |
| 7 | What you meant by dryness fraction. | 3 |
| 8 | Write and explain the Van der Waals Equation of state. | 3 |
| 9 | Define Gibbs function and state their significance | 3 |
| 10 | Explain Kay's rule of real gas mixtures | 3 |

PART B

(Answer one full question from each module, each question carries 14 marks)

Module -1

- | | | |
|----|--|---|
| 11 | a) Explain the concept of continuum | 7 |
| | b) The temperature (T) on a thermometric scale is defined in terms of a property K by the relation
$T = a \ln K + b$, where a and b are constants.
The values of K are found to be 1.8 and 6.5 at the ice point and the steam point, the temperatures of which are assigned the numbers 0 and 100 respectively.
Determine the temperature corresponding to a reading of K equal to 2.8 on the thermometer. | 7 |
| 12 | a) Differentiate point function and path function with suitable examples | 7 |
| | b) Explain the Zeroth law of thermodynamics and discuss the temperature | 7 |

measurement method used before 1954.

Module -2

- 13 a) A piston-cylinder device with air at an initial temperature of 30°C undergoes an expansion process for which pressure and volume are related as given below: 7

P(kPa)	100	37.9	14.4
V (m ³)	0.1	0.2	0.4

Calculate the work done by the system.

- b) State first law of thermodynamics for closed system undergoing a change of state and show that energy a property of system. 7
- 14 a) Derive the Steady Flow Energy Equation (SFEE) applied to a Turbine 7
- b) In a steady flow apparatus, 125 kJ of work is done by each kg of fluid. The specific volume of fluid, pressure, and velocity at inlet are $0.35\text{ m}^3/\text{kg}$, 600 kPa and 15 m/s. The inlet is 32 m above floor and discharge pipe is at floor level. The discharge conditions are $0.60\text{ m}^3/\text{kg}$, 100 kPa and 275 m/s. The total heat loss between inlet and discharge is 10 kJ/kg. In flowing through this apparatus, what will be the change in specific internal energy? 7

Module -3

- 15 a) A cyclic heat engine operates between a source temperature of 900°C and a sink temperature of 40°C . What is the least rate of heat rejection per kW net-work output of the engine? 7
- b) 1 kg of water at 273 K is brought into contact with a heat reservoir at 373 K. When the water has reached 373 K, find the entropy change of the water of the heat reservoir and of the universe. 7
- 16 A) Derive the Clausius inequality equation and write the criterion for reversible cycle, irreversible cycle and impossible cycle 7
- b) Derive the expression for the entropy change for a closed system. 7

Module -4

- 17 a) Explain the P-v diagram of pure substance that contract during freezing. Explain the concept of triple point and write down the pressure, temperature and specific volume corresponds to triple point of water. 7
- b) Steam initially at 0.3 MPa, 250°C is cooled at constant volume. (i) At what 7

temperature will steam become saturated vapour? (ii) What is the dryness fraction at 80°C? (iii) What is the heat transferred per kg of steam in cooling from 250°C to 80°C.

- 18 a) Explain and discuss the significance of Virial equations of state. 7
b) What are the reasons for deviation of real gas behaviour from ideal gas behaviour? Discuss the need for compressibility factor and compressibility chart 7

Module -5

- 19 a) The ratio of specific heats (γ) for acetylene (C_2H_2) is found to be 1.26. Find c_p and c_v for acetylene. 7
b) Derive the expressions for the equivalent molecular weight and characteristic gas constant for an ideal gas mixture. 7
- 20 a) Derive the Tds Equations using Maxwell relations and explain its significance 7
b) Derive Clapeyron Equation for evaporation of liquids. Explain the significance of Clapeyron Equation using p-T diagram. 7
