Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S4 (S,FE) (FT/WP) (S2 PT) Examination December 2025/January 2026 (2019 Scheme)

Course Code: MET202

Course Name: ENGINEERING THERMODYNAMICS

Max. Marks: 100 Duration: 3 Hours

(Permitted to use steam tables and Mollier charts)

PART A

(Answer all questions; each question carries 3 marks)

		Marks
1	How would you compare and contrast classical thermodynamics and statistical thermodynamics?	3
2	Describe the quasi-equilibrium process undergone by a system and why it is important.	3
3	Why does free expansion have zero work transfer?	3
4	Prove that for an isolated system, there is no change in internal energy.	3
5	Define a PMM2. Why is it impossible?	3
6	With the help of a neat sketch, show that the COP of a heat pump is greater than the COP of a refrigerator by unity.	3
7	Write a short note on the Mollier diagram.	3
8	Explain how the universal gas constant can be derived from the characteristic gas constant.	3
9	Explain Dalton's law of partial pressures.	3
10	Differentiate mass fraction and mole fraction.	3

PART B

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

Module -1

11	a)	Using the principles of a constant volume gas thermometer, explain how it can be employed to determine the accurate value of the steam point.	7
	b)	Describe about (i) system and control volume (ii) properties and state (iii) path and process with respect to thermodynamics	7
12	a)	How was temperature measured before 1954, and how can the equation used in this method be derived?	7
	b)	Explain the working of a thermocouple with a neat sketch.	7

Module -2

13	a)	Derive the equation for p-dv work in a polytropic expansion process.	7
	b)	How can the first law of thermodynamics be applied to closed systems undergoing a cyclic change? Explain with Joule's experiment.	7

14	a)	Derive the Steady Flow Energy Equation. Prove that fluid enthalpy before and after throttling are the same.	7
	b)	The following equation gives the internal energy of a certain substance, u = 3.56 pv+84, where 'u' is given in kJ/kg, 'p' is in kPa, and 'v' is in m^3/kg. A system composed of 3 kg of this substance expands from an initial pressure of 500 kPa and a volume of 0.22 m^3 to a final pressure of 100 kPa in a process in which pressure and volume are related by $pv^{1.2} = C$. If the expansion is quasi-static, find Q, W and ΔE for the process.	7

Module -3

15	a)	With the help of neat sketches, prove that Kelvin Planck and Clausius statements of second law are equivalent.	7
	b)	State and prove Carnot's Theorem.	7
16	a)	10 grams of water at 20 °C is converted to ice at -5 °C at constant atmospheric pressure. Assuming the specific heat of liquid to remain constant at 4.2 kJ/kg.K and that of ice to be half of this value and taking the latent heat of fusion of ice at 0 °C to be 335 kJ/kg. Calculate the total entropy change of the system.	7
	b)	Using Clausius' theorem, explain why heat transfer at a lower temperature contributes more to entropy change than heat transfer at a higher temperature.	7

Module -4

17	a)	Explain the p-v diagram of a pure substance other than water with the help of neat sketches. Write the critical pressure, critical temperature, and critical volume of water.	7
	b)	What are Virial equations of state? Also derive the relation between Virial expansion coefficients B' and B, C' and C, and D' and D for a real gas.	7
18	a)	Find the enthalpy and entropy of steam when the pressure is 3 MPa and specific volume is 0.06 m^3/kg.	7
	b)	Give descriptions on the following. 1. Compressibility factor, 2. Reduced properties and 3. Generalized compressibility chart.	7

Module -5

19	a)	Demonstrate how Amagat's law of additive volumes can be used to predict the total volume of a gas mixture under specific conditions	7
	b)	Derive Maxwell relations, beginning from the appropriate combined first and second laws.	7
20	a)	Explain the significance of Joule-Thomson coefficient in the context of thermodynamics. Show that Joule-Thomson coefficient is zero for an ideal gas.	7
	b)	Derive first and second T-ds equations.	7

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