Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S4 (R,S) (FT/WP) / (S2 PT) Exam April 2025 (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		Describe any three conditions to be satisfied for a system to be in thermodynamic equilibrium.	3
2		How would you compare and contrast classical thermodynamics and statistical thermodynamics?	3
3		Prove that the energy of an isolated system is constant.	3
4		Discuss the limitations of first Law of Thermodynamics	3
5		Explain the concept of dead state and its role in determining availability	3
6		What are the causes of irreversibilities? Explain in detail.	3
7		Explain the significance of the compressibility factor in thermodynamics.	3
8		Write the ideal gas equation for 'n' moles of a gas. Explain each term used in the equation with proper units in SI. How the characteristic gas equation can be obtained from this equation?	3
9		Differentiate mass fraction and mole fraction.	3
10		Explain Kay's rule for real gas mixtures.	3

PART B

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

Module -1

11	a)	Describe the concept of thermometric property and explain how these concepts are applied in various types of thermometers	7
	b)	Describe and analyze the operational principles of an electrical resistance thermometer, utilizing a detailed schematic diagram to illustrate its functionality	7
12	a)	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 1.83 and 6.78 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 2.42 on the thermometer.	7
	b)	How was temperature measured before 1954, and how can the equation used in this method be derived?	7

Module -2

13	a)	A stationary mass of gas is compressed without friction from an initial state of 0.3 m^3 and 0.105 MPa to a final state of 0.15 m^3 and 0.105 MPa, the pressure remaining constant during the process. There is a transfer of heat 37.6 kJ from the gas during the process. How much does the internal energy of the gas change?	7
	b)	Air flows steadily at the rate of 0.5 Kg/s through an air compressor, entering at 7 m/s velocity, 100 KPa pressure and 0.95 m^3 /Kg volume and leaning at 5 m/s, 700 KPa and 0.19 m^3/Kg. the internal energy of the air leaving is 90 KJ/Kg greater than that of the air entering. Cooling water in the compressor jackets absorbs heat from the air at the rate of 58 KW (i). compute the rate of shaft work input to the air in KW, (ii). Find the ratio of the inlet pipe diameter to the outlet pipe diameter.	7
14	a)	Deduce steady flow energy equation for (i) Nozzle (ii) Turbine and (iii) compressor.	7
	b)	Derive the equation for p-dv work in a polytropic expansion process.	7

Module -3

15	a)	Compare the heat pump and refrigerator. With neat sketches, show that the COP of a heat pump is greater than the COP of a refrigerator by Unity.	7
	b)	Derive expressions for entropy change during a) constant volume process b) isothermal process	7
16	a)	Calculate the entropy change of the universe as a result of the following process: A copper block of 600 gm mass with a Cp of 150 J/K at 100 °C is placed in a lake at 8 °C.	7
	b)	State and prove Carnot's Theorem.	7

Module -4

17	a)	Draw the T-s plot of a pure substance, and show various constant property lines on it .	7
	b)	Give descriptions on the following. 1.Virial expansions, 2. Law of corresponding states and 3.Generalized compressibility chart.	7
18	a)	A reversible adiabatic process begins at P_1= 10 bar, t = 300 °C and ends with P_2 = 1 bar. If the fluid is steam, find the specific volume, final enthalpy, and work done per kg of fluid.	7
	b)	What are reasons for the deviation of the real gas behaviour from the ideal gas behaviour? With reference to van der Waals correction, explain the deviation of equation of state of a real substance from ideal gas.	7

Module -5

19	a)	State and prove Dalton's law of partial pressures.	7
	b)	Derive T-ds equations	7
20	a)	What is a throttling process? Give a description on Joule Thomson coefficient with its significance.	7
	b)	Explain how the molecular weight, enthalpy and internal energy of an ideal gas mixture is found out if the corresponding quantities of component gases are given.	7

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