Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fourth Semester B.Tech Degree Examination June 2022 (2019 scheme)

Course Code: MRT202

Course Name: THERMODYNAMICS

Max. Marks: 100 Duration: 3 Hours

Use of Steam tables is permitted.

PART A

(Answer all questions; each question carries 3 marks) Marks

1		Differentiate intensive and expensive properties	3
2		Define Zeroth's law of thermodynamics. Give an example.	3
3		State the limitations of the first law of thermodynamics.	3
4		What is the steady flow energy equation for condensers?	3
5		State the use of the Clausius inequality theorem.	3
6		What are the causes and effects of irreversibility?	3
7		What is the triple point of water?	3
8		What is the compressibility factor?	3
9		What are Helmholtz function and Gibb's function?	3
10		What is Amagat's law?	3

PART B

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

Module -1

11	a)	Differentiate the types of thermodynamic systems?	7
	b)	Explain thermodynamic equilibrium?	7
12	a)	Explain the quasistatic process and the property changes?	7
	b)	Discuss point and path functions?	7

Module -2

13	a)	Gas from a bottle of compressed helium is used to inflate an inelastic flexible balloon, originally folded completely flat to a volume of 0.5m3. If the barometer reads 760mm of Hg What is the amount of work done upon the atmosphere by the balloon?	7
	b)	The airspeed of a turbojet engine in flight is 270 m/s. The ambient air temperature is -15°C. The gas temperature of the outlet of the nozzle is 600°C.	7

Corresponding enthalpy values for air and gas are respectively 260 and 912 kJ/kg Fuel-air ratio is 0.019 Chemical energy of the fuel is 44.5 MJ/kg. Due to incomplete combustion, 5% of the chemical energy is not released in the reaction. Heat loss from the engine is 21 kJ/kg of air. Calculate the velocity of the exhaust jet.

14 a) A certain water heater operates under steady flow conditions receiving 4.2 kg/s of water at 75°C temperature, enthalpy 313.93 kJ/kg. The water is heated by mixing with steam which is supplied to the heater at temperature 100.2°C and enthalpy 2676 kJ/kg. The mixture leaves the heater as liquid water at temperature 100°C and enthalpy 419kJ/kg. How much steam must be supplied to the heater per hour? 7

b) 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 is remaining constant. During the process, there is a transfer of 37.6 kJ of heat from the gas during the process. How much does the internal energy of the gas change? 7

Module -3

15 a) Explain the equivalence of the second law of thermodynamics? 7

b) Explain the reversibility? 7

16 a) A cold storage is to be maintained at – 5°C while the surroundings are at 35°C. The heat leakage from the surroundings to the cold storage is estimated to be 29 kW. The actual COP of the refrigeration plant is one-third of an ideal plant working between the same temperatures. Find the power required to run the plant. 7

b) A reversible engine is supplied with heat from two constant temperature sources at 900 K and 7

600 K and rejects heat to a constant temperature sink at 300 K. The engine develops work equivalent to 90 kJ/s and rejects heat at the rate of 56 kJ/s. Estimate i. Heat supplied by each source and ii. Thermal efficiency of the engine.

Module -4

17 a) Explain T-s diagram for steam formation? 7

b) Show the various thermodynamic processes using Mollier diagram? 7

18	a)	Explain are working of separating colorimeter?	7
	b)	Using Mollier chart, find the enthalpy drop and final condition of steam when it is expanded isentropically from an initial pressure of 30 bar and 350° C to a pressure of 1 bar. Also, find the turbine's work output if the mass flow rate of steam is 10 kg/s if turbine efficiency is 88%.	7

Module -5

19	a)	Explain gravimetric and volumetric analysis?	7
	b)	Derive Vander Waals equation of state?	7
20	a)	Derive Maxwell's relations.	7
	b)	Derive Joule-Thompson coefficient.	7

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