Reg No.:_______________ Name:__________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

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

1	a)	Define a thermodynamic systems	(3)
	b)	Distinguish between intensive and extensive properties. Give examples	(3)
	c)	Explain thermodynamic equilibrium.	(4)
2	a)	How does resistance thermometer measure temperature?	(3)
	b)	Show that heat is path function and not a property	(3)
	c)	Define enthalpy. Why enthalpy of an ideal gas depends only on temperature?	(4)
3	a)	Which property of a system increases when heat is transferred: (a) at constant volume (b) at constant pressure	(4)
	b)	A mass of 8kg gas expands within a flexible container so that the p-v relationship is of the form $pv^{1.2}$=constant. The initial pressure is 1000kPa and the initial volume is 1m^3. The final pressure is 5 kPa. If specific internal energy of the gas decreases by 40kJ/kg, find the heat transfer in magnitude and direction.	(6)
4	a)	Derive the steady flow energy equation for a bottle filling process using system approach.	(5)
	b)	In a gas turbine the gas enters at the rate of 5 kg/s with a velocity of 50m/s and enthalpy of 900 kJ/kg and leaves the turbine with a velocity of 150m/s and enthalpy of 400kJ/kg. The loss of heat from the gases to the surroundings is 25kJ/kg. Assume for gas R = 0.285kJ/kgK and c_p = 1.004kJ/kgK and the inlet conditions to be at 100 kPa and 27°C. Determine the power output of the turbine and the diameter of the inlet pipe.	(5)

PART B

Answer any three full questions, each carries 10 marks.

5	a)	Explain the two statements of Second law of thermodynamics. Why PMM2 is impossible	(5)
	b)	A heat engine operating between two reservoirs at temperatures 600^{0}C and 40^{0}C drives refrigerator operating between reservoirs at temperatures of 40^{0}C and -15^{0}C. The heat transfer to the heat engine is 2500kJ and the net work output of the combined engine and refrigerator plant is 400kJ. The efficiency of the heat engine and COP of the refrigerator are each 40% of the maximum possible values. Estimate the heat transfer to the refrigerant and net heat transfer to the reservoir at 40°C.	(5)
6	a)	State and prove Clausius theorem	(5)
	b)	Determine the maximum work obtainable by using one finite body at temperature	(5)

T and a thermal energy reservoir at temperature T_0, $T>T_0$

7 a) Why second law is called law of degradation? (3)

b) Derive the expression for reversible work done by a closed system if it interacts only with the surroundings (7)

8 a) Draw the phase equilibrium diagram for a pure substance on h-s plot with relevant constant property lines (3)

b) Steam flows in a pipeline at 1.5MPa. After expanding to 0.1MPa in a throttling calorimeter, the temperature is found to be 120°C. Find the quality of steam in the pipeline. What is the maximum moisture at 1.5MPa that can be determined with this set-up if at least 5°C of superheat is required after throttling for accurate reading? (7)

PART C

Answer any four full questions, each carries 10 marks.

9 a) Discuss compressibility factor and law of corresponding states. (5)

b) A fluid having a temperature of 150°C and a specific volume of 0.96 m^3/kg at its initial state expands at constant pressure, without friction, until the volume is 1.55 m^3/kg. Find, for 1kg of fluid, the work, the heat transferred and the final temperature if (a) the fluid is air and (b) the fluid is steam. (5)

10 Express the changes in the internal energy and enthalpy of an ideal gas in a reversible adiabatic process in terms of pressure ratio (10)

11 a) State and explain Amagat's law of partial volumes of a gas mixture (10)

12 a) Derive Maxwell's equations (10)

13 a) Discuss the Joule-Thomson effect with a T-P plot. Prove that Joule Thomson coefficient is zero for ideal gas. (10)

14 a) Explain degree of reaction. What are its limiting values? (5)

b) Define equivalence ratio. What is its significance in combustion process? (5)

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