Final- 01-11-21

Course Code: 1930315 **Roll No:** **MLRS- R19**

MARRI LAXMAN REDDY
INSTITUTE OF TECHNOLOGY AND MANAGEMENT
(AN AUTONOMOUS INSTITUTION)
(Approved by AICTE, New Delhi & Affiliated to JNTUH, Hyderabad)
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II B.Tech I Sem Supply End Examination, November 2021

THERMODYNAMICS
(MECHANICAL)

Time: 3 Hours. **Max. Marks: 70**

Note: 1. Answer any FIVE questions.
2. Each question carries 14 marks and may have a, b as sub questions.

1	a)	Define a "Pure Substance". How many properties are needed to specify the state of a pure substance? What are intensive and expensive properties? Give at least two illustrations for each.	6M	CO1	BL1
	b)	Differentiate between macroscopic and microscopic view analysis	8M	CO1	BL2
2	a)	What is flow work? To which of the thermodynamic systems it is related? Obtain the expression to evaluate flow work.	6M	CO1	BL1
	b)	A stationary fluid system undergoes a thermodynamic cycle, which comprises of following processes: (i) Process 1-2: Isochoric heat addition of 250 kJ/kg (ii) Process 2-3: Adiabatic expansion to its original pressure with loss of 60 kJ/kg in internal energy (iii) Process 3-1: Isobaric heat rejection to its original volume by rejecting heat of 200 kJ/kg. What thermodynamic cycle is this? And evaluate energy interactions during each process and find the overall changes in the cycle.	8M	CO1	BL3
3	a)	State the Second Law of Thermodynamics using Clausius and Kelvin Plant statements. Why is the second law called the directional law of nature?	6M	CO2	BL1
	b)	An iron block of unknown mass at 85°C is dropped into an insulated tank that contains 0.1 m^3 of water at 20°C. At the same time, a paddle wheel driven by a 200 W motor is activated to stir the water. Thermal equilibrium is established after 20 min, when the final temperature is 24°C. Determine the mass of the iron block and the entropy generation during the process.	8M	CO2	BL3
4	a)	10kg of water at 45°C is heated at a constant pressure of 10 bar until it becomes a superheated vapor at 300°C. Find the change in volume, enthalpy, internal energy and entropy.	7M	CO3	BL2
	b)	Air is contained in a cylinder fitted with frictionless piston. Initially the cylinder contains 0.5 m^3 of air at 1.5 bar, 20°C. The air is then compressed reversibly according to the law, $Pv^n = C$, until the final pressure is 6 bar, at which the temperature is 120°C. Determine i) polytropic index, ii) the final volume of air, iii) work done on air and the heat transfer and iv) the net change in entropy.	7M	CO3	BL2

5	a)	A heat pump working on the Carnot cycle takes in heat from a reservoir at 5°C and delivers heat to a reservoir at 60°C. The heat pump is driven by a heat engine which takes heat from a reservoir at 840°C and rejects heat to a reservoir at 60°C. The reversible heat engine also drives a machine that absorbs 30 kW energy. If the heat pump extracts 17 kW from 5°C reservoir, determine a) the rate of heat supplied from 840°C reservoir and the rate of heat rejection to 60°C reservoir.	8M	CO2	BL3
	b)	Briefly explain about the Joule – Kelvin effect.	6M	CO3	BL1
6	a)	What is compressibility factor? Briefly explain the generalized compressibility chart.	7M	CO4	BL1
	b)	0.5 kg of Helium and 0.5 kg of Nitrogen are mixed at 20°C and at a total pressure of 100 kPa. Find i) volume of the mixture, ii) specific heats of the mixture and iii) Gas constant of the mixture.	7M	CO4	BL2
7	a)	Explain the following process with the help of a Psychrometric chart and give expressions for energy interactions involved: i) Sensible cooling and ii) Sensible heating	7M	CO4	BL1
	b)	In an ideal Brayton cycle, air from the atmosphere at 1 atm, 300K is compressed to 6 atm and the maximum cycle temperature is 1100K. If the heat supply is 100 MW, find the thermal efficiency of the cycle and the work ratio.	7M	CO5	BL3
8	a)	With the help of P-v and T-s diagrams, explain the Stirling Cycle.	7M	CO5	BL1
	b)	Draw p-v and T-s diagrams of Otto cycle and explain briefly.	7M	CO5	BL3

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