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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Third Semester, B.E. - Automobile Engineering

Semester End Examination; March / April - 2022

Thermodynamics

Time: 3 hrs *Max. Marks: 100*

Course Outcomes

The Students will be able to:

CO1: Design and Implement standard data structures like stack using recursion.

CO2: Design and implement operations on linked list.

CO3: Develop programs to implement different queues.

CO4: Design and implement different tree traversal techniques using iteration and recursion.

CO5: Implement sorting and searching techniques.

Note: ***I) PART - A*** *is compulsory.* ***Two*** *marks for each question.*
II) PART - B*: Answer any* ***Two*** *sub questions (from a, b, c) for Maximum of* ***18 marks*** *from each unit.*
III) *Assume suitably missing data if any.* ***IV)*** *Use of Thermodynamic data and book is permitted.*

Q. No.		Questions	Marks	BLs	COs	POs
		I : PART - A	**10**			
I	a.	Define Zeroth law of thermodynamics.	2	L1	CO1	PO1
	b.	State first law of thermodynamics for cyclic and non-cyclic processes.	2	L2	CO2	PO1
	c.	Differentiate between heat engine and reverse heat engine.	2	L3	CO3	PO2
	d.	Compare the air standard efficiency equations of Otto and diesel cycles.	2	L3	CO3	PO1
	e.	Compare dry bulb and wet bulb temperature.	2	L5	CO5	PO1
		II : PART - B	**90**			
		UNIT - I	**18**			
1	a.	Explain the terms; Closed system, Intensive property, Thermodynamic equilibrium, Quasi-static process and state.	9	L2	CO1	PO1
	b.	The temperature scale of a certain thermometer is given by the relation $t = al_nX + b$, where 'a' and 'b' are constants and 'X' is the thermometric property of the fluid in the thermometer. If at the ice and steam point, the thermometric property, are found to be 1.5 and 7.5 respectively, determine the temperature corresponding to thermometric property 3.5.	9	L4	CO1	PO2
	c.	A Spherical balloon has a diameter of 30 cm contains air at a pressure of 1.5×10^5 Pa. The diameter of balloon increases to 40 cm in a certain process and during this process, the pressure is proportional to diameter. Determine work done by air inside balloon during this process.	9	L4	CO1	PO2

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UNIT - II **18**

2 a.	Prove that energy is the property of the system and state first law of thermodynamics for cyclic and non-cyclic processes.	9	L3	CO2 PO2
b.	The Internal energy of certain substance is given by equation $n = 3.60\ PV + 90$ where 'n' is in kJ/kg, P is in kPa and V is in m^3/kg. A system composed of this substance expands from an initial pressure of 500 kPa and a volume of 0.22 m^3 to a final pressure, 100 kPa in a process in which pressure and volume are related as $PV^{1.2} = C$. If the process is quasi-static determine the heat transfer, change in internal energy and work done.	9	L4	CO2 PO2
c.	In a gas turbine unit, gas flows through the turbine at 17 kg/s and power developed by turbine is 14000 kW. The enthalpies of gasses at inlet and outlet as 1200 kJ/kg and 360 kJ/kg respectively. The velocities at inlet and outlet are 60 m/s and 150 m/s respectively. Determine the rate at which heat is rejected from turbine. Also, determine the area of the inlet and outlet pipes, given specific volume of gasses at inlet and outlet as 0.35 m^3/kg and 0.5 m^3/kg respectively.	9	L4	CO2 PO2

UNIT - III **18**

3 a.	State second laws of thermodynamics. Prove that violation of Clausius statement leads to violation of Kelvin-Planck statement.	9	L3	CO3 PO1
b.	A reversible heat engine operating between two reservoirs at temperature 600ºC and 40ºC. The Engine drive a refrigerator which operates between reservoirs at temperatures of 40ºC and −25ºC. The heat transfer to the engine is 2000 kJ and the net work output of the combined engine and refrigerator plant is 360 kJ. Determine the heat transfer to the refrigerator and the net heat transfer the reservoir at 40ºC.	9	L1	CO3 PO1
c.	Describe the working of Carnot cycle and derive an expression for thermal efficiency.	9	L3	CO3 PO1

UNIT - IV **18**

4 a.	Derive an expression for air standard efficiency of a diesel cycle.	9	L3	CO4 PO1
b.	In an air standard Otto cycle the compression ratio is 7:1 and the compression begins at 35ºC and 0.1 MPa. The maximum temperature of the cycle is 1100ºC. Determine; i) Temperature and pressure at each end of process ii) The heat supplied iii) Cycle efficiency	9	L4	CO4 PO2

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c. Two stage compressor with perfect inter cooling takes in air at 1 bar pressure and 27ºC. The compression path follow $PV^{1.3} = C$. The compressed air delivered at 10 bar from the high pressure cylinder to an air receiver. Determine per kg of air, (i) minimum work done and (ii) heat rejected in the intercooler. 9 L4 CO4 PO2

UNIT - V **18**

5 a. Explain the Carnot refrigeration cycle with suitable *P-V* and *T-S* diagrams. 9 L3 CO5 PO1

b. Explain the working of vapour compression refrigeration cycle. 9 L2 CO5 PO2

c. A refrigerant-12 vapour compression plant producing 10 tonnes of refrigeration operates with condensing and evaporating temperatures of 35ºC and 10ºC respectively. The suction line heat exchanger is used to sub cool the saturated liquid leaving the condenser. Saturated vapour leaving the evaporator is superheated in the suction line. Heat exchanger to the extent that a discharge temperature of 60ºC is obtained after isentropic compression. Determine; 9 L4 CO5 PO2

i) Sub cooling achieved in heat exchanger

ii) Refrigerant flow rate in kg/s

iii) COP of plant

iv) Power required to drive compressor

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