23AEPC210

MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

(A Unit of Rajalaxmi Education Trust®, Mangalore)
Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi
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Model Question Paper

Fourth Semester BE Degree Examination

Aerothermodynamics

Time: 3 Hours **Max. Marks: 100**

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M: Marks, L: RBT (Revised Bloom's Taxonomy) level, C: Course outcomes.
3. Use of Thermodynamics Data handbook is allowed.

		Module -1	M	L	C
Q1	a.	What is a Quasi-Static process? Explain with a neat diagram.	6	L2	CO1
	b.	Sketch and explain open system and closed system with suitable examples.	4	L2	CO1
	c.	State Zeroth law of thermodynamics. The readings tA and tB of two Celsius thermometers A and B agree at ice & steam point, but elsewhere are related by the equation $tA=L+MtB+NtB^2$ where L, M & N are constants, when both thermometers are immersed in a system of fluid, A registers 11°C while B registers 10°C. Determine the reading on A when B registers 37.4°C	10	L3	CO2
		OR			
Q2	a.	What are the 3 types of heat transfer process? Explain with suitable examples.	6	L2	CO1
	b.	What are the differences between work and heat? Explain.	4	L2	CO1
	c.	A gas initially at 100 KPa and 6000 cm^3. The final volume is 2000 cm^3. Determine the moving boundary work for each of the following processes. i) P is inversely proportional to V ii) P is inversely proportional to V^2 iii) P is directly proportional to V iv) P is directly proportional to V^2	10	L3	CO2
		Module- 2			
Q3	a.	State First Law of thermodynamics for closed system. Explain the Joules Experiment.	10	L2	CO1
	b.	A system receives 180kJ of heat in a constant volume process. Next it undergoes a constant pressure process in which it rejects 200kJ of heat and receives 50kJ of work a) if the system is brought back to its original state by an adiabatic process, determine magnitude and direction of work for third process. b) Taking energy at initial state as zero determine energy at other two state.	10	L3	CO2
		OR			
Q4	a.	Define steady flow process, state expression for steady flow energy equation with the assumptions considered. Illustrate any two engineering applications of steady flow energy equation.	10	L2	CO1
	b.	A mass of 8 kg gas expands within a flexible container according to law $PV^{1.2}=C$. The initial pressure is 1000kPa and initial volume is 1m3. The final pressure is 5kPa. If the specific internal energy of the gas decreases by 40kJ/kg. Determine the magnitude and direction of heat transfer.	10	L3	CO2

Module – 3					
Q5	a.	Prove that violation of Clausius statement leads to the violation of Kelvin Plank statement.	10	L3	CO2
	b.	Two reversible engines A and B are in series. A receives 200kJ from HTR at 421^0C, B rejects heat to sink at 4.4^0C. If the work of A is twice of B, determine intermediate temperature, efficiency of A and B, Heat rejected to sink.	10	L3	CO2
OR					
Q6	a.	Derive the performance equation for i) Heat Engine, ii)Refrigerator, iii) Heat Pump. Prove that $(COP)_{HE} = (COP)_R + 1$.	10	L3	CO2
	b.	The COP of a heat pump is 5 and power required to drive it is 35kW. Heat from heat pump is used to heat the water circulating the radiators of the building. Determine the heat transfer from and to working fluid, mass flow rate of water if its temperature rises by 200 degree C.	10	L3	CO2
Module - 4					
Q7	a.	In a test to find the quality of the steam in a pipe using a combined separating and throttling calorimeter, the following data was obtained. Pressure of steam in the steam main = 14 bar, Barometer reading = 735 mmHg, Manometer reading = 170 mm Hg, Temperature after throttling = 120°C, Water collected in the separator = 0.45 kg, Steam condensed after throttling = 6.75 kg. Determine the condition of the steam in the main. Take Cp for superheated steam = 2.1 kJ/Kg K. If the separator is removed, what would be the limiting quality of the steam in the pipe which could be determined by the throttling calorimeter alone, assuming the same pressure after throttling?	10	L3	CO3
	b.	Explain the law of corresponding states and compressibility factor.	5	L2	CO4
	c.	State and explain the Daltons Law.	5	L2	CO4
OR					
Q8	a.	3 kg of steam at 18 bar occupies a volume of 0.225 cubicmeter. During a constant volume process to 10 bar. Determine a) Final Dryness fraction, b) Final internal energy, c) Change in entropy, d) Work done.	10	L3	CO3
	b.	State and explain Van-der Waal's Equation.	5	L2	CO4
	c.	State and explain the Avogadros Law.	5	L2	CO4
Module - 5					
Q9	a.	With the help of a P-V and T-S diagram, derive an expression for the air standard efficiency of a Diesel cycle.	10	L3	CO5
	b.	The minimum pressure and temperature of the air standard Carnot cycle are 1 bar and 15°C respectively. The pressure after isothermal compression is 3.5 bar and the pressure after isentropic compression is 10.5 bar. Determine i) Efficiency ii) Mean effective pressure and the Power developed if the Carnot engine makes 2 cycles/s. Take for air R=0.287kJ/kgK and γ=1.4	10	L3	CO5
OR					
Q10	a.	With the help of a P-V and T-S diagram, derive an expression for the air standard efficiency of a Otto cycle.	10	L3	CO5
	b.	A petrol engine works on Otto cycle under ideal conditions. The initial pressure before the beginning of compression is 101kPa at 340K. The pressure at the end of heat addition process is 3.5Mpa. As per the details furnished by the manufacturer engine has stroke length twice the bore. Engine bore is 300mm and clearance volume $4x10^{-3}$ m^3. Determine: i) compression ratio ii) air standard efficiency iii) mean effective pressure	10	L3	CO5

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