CBCS SCHEME

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BAE401

Fourth Semester B.E./B.Tech. Degree Examination, June/July 2024
Aero Engineering Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.
3. Thermodynamic data handbook is permitted.

		Module – 1	M	L	C
Q.1	a.	What are open system, closed system and isolated system? Give examples of each.	6	L2	CO1
	b.	Derive the expression for Celsius and Fahrenheit scale and explicitly bring out these relationship.	8	L3	CO1
	c.	A readings t_A and t_B of two Celsius thermometer A and B agree at ice point and steam point but else where they are related by the equation. $t_A = L + Mt_B + n t_B^2$. Where L, M and n an constant when both the thermometer are immersed in oil A indicates 55°C and B indicates 50°C, determine the values of constant L, M and n and also the temperature readings on thermometer A when B reads 25°C	6	L4	CO1
		OR			
Q.2	a.	With the help of neat sketch prove that free expansion has zero work transfer.	8	L5	CO1
	b.	Obtain an expression for workdone by the isothermal process.	4	L3	CO1
	c.	A spherical balloon has a diameter of 20cm and it contains air at a pressure of 1.5bar during a certain process the diameter of a balloon increases to 30cm during which the pressure in proportional to diameter. Calculate the work done by the air inside the balloon during this process.	8	L4	CO1
		Module – 2			
Q.3	a.	Prove that for a polytropic process. $Q_{1-2} = \left(\frac{\gamma - n}{\gamma - 1}\right) W_{1-2}$	10	L5	CO2
	b.	Show that on the PV diagram the isentropic lines are steeper them the isothermal lines, when these two lines pass through a given state of the system.	5	L4	CO2
	c.	An auditorium with a seating capacity of 1000 person has a air-conditioning system which has failed suddenly, the rate of that transfer from each person to the surroundings amounts to 400kJ/hr How much does the internal energy of the air in the auditorium increase during the 1st 30 minutes after the air condition system has failed.	5	L5	CO2
		OR			

Q.4	a.	Derive an expression for steady flow work from the steady flow energy equation.	10	L3	CO2
	b.	Show that for an isentropic process. $(W_{1-2})_{Flow\ work} = \gamma \cdot (W_{1\text{-}2})_{Non\ flow\ work}$	5	L4	CO2
	c.	2Kgs of super heated steam is passed to a steam turbine per second. The heat loss from the turbine is 10kW. The properties of steam at the inlet and the outlet are as follows : Inlet: P = 2MPa, h = 3140kJ/Kg, c = 50 m/s Outlet: P = 0.1 MPa, h = 2680kJ/Kg, c = 200 m/s Find the power output of the turbine assuming that the inlet and the outlet of the turbine are at the same level.	5	L	CO
		Module – 3			
Q.5	a.	State Kelvin Plank and Clausius statement of second law of thermodynamic and show that they all equivalent.	8	L2	CO2
	b.	A reversible engine operates between temperature T_H and T_I with $T_H > T_I$. The energy rejected from this engine is utilized for driving another reversible engine which operates between the temperature limits T_I and T_L with $T_I > T_L$ for this arrangement shows that. i) The temperature T_I is the arithmetic mean of the temperature T_H and T_L, if both the engines produce equal amount of work. ii) The temperature T_I is geometric mean of the temperature T_H and T_L when both the engines have the same thermal efficiency.	12	L5	CO2
		OR			
Q.6	a.	State and prove Clausius in equality.	8	L2	CO2
	b.	Two reversible engine operate in series between a high temperature reservoir and a low temperature reservoir, engine (A) reject heat to engine (B) through an intermediate reservoir maintained at temperature T_I. Engine (B) rejects heat to the low temperature reservoir which is maintained at temperature T_L = 300K, both the engines have the same thermal efficiency, if the work developed by engine (B) is 500kJ and the heat received by the engine (A) is 2000kJ from the high temperature reservoir maintained at temperature T_H obtain the work developed by engine (A). the heat rejected engine (B), the intermediate temperature T_I and the source temperature T_H.	12	L4	CO2
		Module – 4			
Q.7	a.	Define the following : i) Critical point ii) Pure substructure iii) Triple point iv) Saturation pressure.	4	L1	CO2
	b.	Find the enthalpy, specific volume and internal energy if the pressure of stream is 50bar and temperature is 443°C.	8	L3	CO2
	c.	Sketch and explain P-T diagram of water.	8	L2	CO2
		OR			

Q.8	a.	Derive and explain Maxwell's equation.	8	L2	CO2
	b.	1 Kg of ideal gas at pressure P_1, volume V_1 and temperature T_1 follows a reversible process to arrive at state (2) where the properties are P^2, V_2 and T_2 stating from the relation entropy change $ds = \frac{\delta Q}{T}$, derive an expression for change in entropy in terms of pressure and volume, using the derived expression prove that for an adiabatic process $PV^{\gamma} = C$ where γ = ratio of specific heat.	12	L5	CO2
		Module – 5			
Q.9	a.	With the help of PV and TS diagram, explain the working of diesel cycle. Derive an expression for the efficiency of diesel cycle in terms of its compression and act of ratios.	12	L4	CO3
	b.	An Otto cycle has upper and lower temperature limits of T_3 and T_1. If maximum work/kg of air is to be done. Show that the intermediate temperature is given by $T_2 = T_4 = \sqrt{T_1T_3}$. If the temperature limits are 1500K and 300K find the maximum power developed for air circulation of 0.35 Kg/min (Take C_V = 0.706kJ/Kg K).	8	L5	CO3
		OR			
Q.10	a.	Explain Rankine cycle with the help of a sketch and T-S diagram. Derive an expression for thermal efficiency of Rankine cycle.	8	L4	CO3
	b.	What are the methods for increasing the efficiency of Rankine cycle?	4	L2	CO3
	c.	Consider a steam power plant operating on a simple rankine cycle. Steam enters the turbine at 3MPa and 350°C and is condensed in the condenser at a pressure of 75KPa. Determine the thermal efficiency of the cycle.	8	L3	CO3

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