CBCS SCHEME

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BAE401

Fourth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Aero Engineering Thermodynamics

Time: 3 hrs. Max. Marks: 100

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

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	What are Open System, Closed System and Isolated System? Give examples of each.	**06**	**L2**	**CO1**
	b.	Derive the expression for Celsius and Fahrenheit Scale and Explicitly bring out these relationship.	**08**	**L3**	**CO2**
	c.	A thermometric property x is equal to 7.5 cm and 52.5 cm, when the thermometer is in thermal equilibrium with ice point and steam respectively. The temperature varies linearly with x. Now assume that a temperature T on a certain temperature scale is defined by $T = a + bx^2$ where T = 32° and 212° at the ice point and steam point respectively. Find the temperature T on this scale when the temperature is 100°C on the Fahrenheit Scale.	**06**	**L3**	**CO2**
		OR			
Q.2	**a.**	Compare between work and heat.	**06**	**L2**	**CO2**
	b.	Derive an expression for work done for the following process with the help of p.v diagram. i) Constant Pressure Process ii) Constant Temperature Process	**08**	**L3**	**CO2**
	c.	A spherical balloon of diameter 0.5 m is initially having an inside pressure of 100 kpa. Due to heating the pressure inside the balloon increases to 400 kpa during which the inside pressure varies inversely proportional to the square of the diameter of the balloon. Determine the displacement work during this process.	**06**	**L3**	**CO2**
		Module – 2			
Q.3	**a.**	Prove that for a polytropic process. $Q_{1-2} = \left(\frac{y-n}{y-1}\right) \times W_{1-2}$	**10**	**L4**	**CO2**
	b.	90KJ of heat is supplied to a system at a constant volume. The system rejects 95 kJ of heat at constant pressure and 18kJ of work is done on it. The system is brought to its original state by adiabatic process. Determine: i) the adiabatic workdone ii)the values of Internal Energy at all end states if the initial value is 105 kJ.	**10**	**L3**	**CO2**
		OR			
Q.4	**a.**	Derive steady flow Energy Equation from the fundamentals. State the assumptions made the steady flow.	**10**	**L3**	**CO2**
	b.	A centrifugal air compressor delivers 15 kg of air per min. The inlet and outlet conditions are V_1 = 5 m/sec. V_{s1} = 0.5 m^3 / kg and V_2 = 7.5 m / sec, V_{s2} = 0.15 m^3 / kg. The Increase in Enthalpy of air passing through the compressor is 170 kJ/kg and the heat loss to the surroundings is 750 kJ / min. Find the power of the motor required to drive the compressor and the ratio of inlet pipe diameter to outlet pipe diameter. Inlet and discharge lines are at the same level.	**10**	**L3**	**CO2**

		Module – 3			
Q.5	**a.**	State Kelvin Plank and Clausius statement of Second law of thermodynamic and show that they all equivalent.	**08**	**L3**	**CO2**
	b.	Show schematically and give performance equation are: i) Heat Engine ii) Refrigerator iii) Heat pump	**06**	**L2**	**CO2**
	c.	A heat pump is used for cooling in summer and heating in winter the house is maintained at 24°C year round. The heat loss is 0.44 kW per degree difference between outside and inside temperature. The average outside temperature is 32°C in summer and 4°C in winter. Determine the power required for both heating and cooling.	**06**	**L3**	**CO2**
		OR			
Q.6	**a.**	State and prove Clausius inequality.	**08**	**L2**	**CO2**
	b.	A 5 kg of copper block at 200°C is dropped to an insulated tank with 100 kg of oil is 30°C. Find the increase in Entropy of the universe. Take $C_p = 0.4$ kJ/kg.K, $C_{poil} = 2.1$ kJ/kg.K.	**06**	**L3**	**CO2**
	c.	0.12m^3 of air at 1 bar and 120°C is compressed to $\frac{1}{10\text{th}}$ of the original volume and a pressure of 35bar. Heat is then added at constant pressure until the volume is doubled. Determine the change of entropy during each of these process. Take $C_p = 1.005$ kJ/kgK , $C_v = 0.7165$ kJ/kg, R= 0.287 kJ/kg.K.	**06**	**L3**	**CO2**
		Module – 4			
Q.7	**a.**	Define the following: i) Critical point ii) Triple point iii) Dryness fraction iv) Latent heat v) Pure substance	**10**	**L1**	**CO2**
	b.	One kg of steam at an initial condition of 6 bars and 0.2 dry is heating at constant volume until the pressure is 20 bar. What is the final state of steam and how much heat is added?	**10**	**L3**	**CO2**
		OR			
Q.8	**a.**	Derive and explain Maxwell's Equation.	**08**	**L3**	**CO2**
	b.	0.5 kg of air is compressed reversibily and adiabatically from 80 kPa, 60°C to 0.4 MPa and is then expanded at a constant pressure to original volume. Sketch the process on P – V and T – S diagram. Compute the heat and work transfer for the whole path.	**12**	**L3**	**CO2**
		Module – 5			
Q.9	**a.**	Derive the expression for the air standard efficiency of an otto cycle with the help PV and T – S diagrams.	**10**	**L4**	**CO3**
	b.	0.5 kg of air working a Carnot cycle having a thermal efficiency of 50% the heat transfer to the air during the isothermal expansion is 40 kJ at the beginning of the isothermal expansion, the pressure is 7 bar and the volume is 0.12m^3. Determine. i) The maximum and minimum temperature for the cycle in Kelvin. ii) The volume at the end of isothermal expansion in m^3 iii) The heat transfer for each of the for process in kJ.	**10**	**L3**	**CO3**
		OR			
Q.10	**a.**	With the help of neat schematic diagram, explain the working of Reheat Rankine Cycle and derive an expression for efficiency.	**08**	**L3**	**CO3**
	b.	A turbine is supplied with steam at a pressure of 32 bar and a temperature of 410°C. The steam then expands isentropically to a pressure of 0.08 bar. Find the dryness fraction at the end of expansion and thermal efficiency of the cycle. If the steam is reheated at 5.5 bar to a temperature of 400°C and then expanded Isentropically to pressure of 0.08 bar. What will be the dryness fraction and thermal efficiency of the cycle?	**12**	**L3**	**CO3**