CBCS SCHEME - Make-Up Exam

USN | | | | | | | | | | |

BAE401

Fourth Semester B.E./B.Tech. Degree Examination, June/July 2025
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.

		Module – 1	M	L	C
Q.1	a.	Distinguish between : i) Microscopic and Macroscopic approach ii) Thermal and thermodynamic equilibrium iii) Intensive and extensive properties.	6	L2	CO1
	b.	Differentiate between work and Heat.	4	L1	CO1
	c.	Two mercury in glass thermometers are made up of identical materials and are accurately calibrated at 0°C and 100°C. One has a tube of constant diameter, while the other has a tube of conical bore, 10% greater in diameter at 100°C than at 0°C. Both thermometers have the length, between 0 and 100 subdivided uniformly. What will be the straight bore thermometer read in a place where the conical bore thermometer reads 50 °C.?	10	L3	CO1
		OR			
Q.2	a.	Derive an expression for displacement work polytropic process PV^n = constant and show how the expression changes when n = 0, n = 1, n = 1.4 and n = ∞.	10	L3	CO1
	b.	As an engineering student suggest the most economical process, when it is desired to compress one mole of air (γ = 1.4) from an initial state of 300 K and 1 bar to a final state of 300 K and 10 bar among the following process: i) Isothermal compression ii) Cooling at constant pressure followed by heating at constant volume iii) Adiabatic compression followed by cooling at constant volume iv) Heating at constant volume followed by cooling at constant pressure.	10	L3	CO1
		Module – 2			
Q.3	a.	Show that the energy is a property of the system.	5	L1	CO2
	b.	Define Enthalpy, specific heat at constant pressure and specific heat at constant volume and give suitable expressions.	6	L1	CO2
	c.	A piston and cylinder machine contains a fluid system which passes through a complete cycle of four processes. During a cycle, the sum of all heat transfer is -170 KJ. The system completes 100 cycles per min. Complete the following table :	9	L3	CO2

Process	Q(kJ/min)	W(kJ/min)	ΔE(kJ/min)
a – b	0	2,170	-
b – c	21,000	0	-
c – d	-2,100	-	-36,600
d – a	-	-	-

		OR			
Q.4	a.	Explain and write SFEE for the following applications : i) Nozzle and Diffusor ii) Turbine and compressor	10	L1	CO2
	b.	Air flows steadily at the rate of 0.5 Kg/s through an air compressor, entering at 7 m/s velocity, 100 KPa pressure and 0.95 m^3/Kg volume and leaving at 5m/s, 700 KPa and 0.19m^3/Kg. The internal energy of the air leaving is 90kJ/KG greater than that of the air entering. Cooling water in the compressor jacket absorbs heat from the air at the rate of 58kW. i) Compute the rate of shaft work input to the air in kW ii) Find the ratio of inlet pipe diameter to outlet pipe diameter.	10	L3	CO2
		Module – 3			
Q.5	a.	State Kelvin – Planck's and Clausius statement of second law of thermodynamics and "prove their equivalence.	10	L2	CO2
	b.	A reversible heat engine operates between two reservoirs at temperatures of 600°C and 40°C. The engine drives a reversible refrigerator which operates between reservoirs at temperatures of 40°C and -20°C. The heat transfer to the heat engine is 2000 KJ and the network output of the combined engine refrigerator plant is 360 KJ. i) Evaluate the heat transfer to the refrigerant and the net heat transfer to the reservoir at 40°C. ii) Reconsider (i) given that the efficiency of the heat engine and the COP of the refrigeration are each 40% of their maximum possible values.	10	L3	CO2
		OR			
Q.6	a.	Which is the more effective way to increase the efficiency of a Carnot engine: to increase T_1, keeping T_2 constant ; or decrease T_2, keeping T_1 constant prove your answer.	10	L3	CO2
	b.	Define Clausius inequality and entropy of a system shown that for an irreversible process, $ds \geq \frac{\delta Q}{T}$.	10	L2	CO2
		Module – 4			
Q.7	a.	A vessel of volume 0.04m^3 contains a mixture of saturated water and saturated steam at a temperature of 250°C. The mass of the liquid present is 9 Kg. Find the pressure, the mass, the specific volume, the enthalpy, the entropy and the internal energy. [Take Data at 250°C ; P_{sat} = 3.973 MPa, V_f = 0.0012512 m^3/Kg, V_g = 0.05013m^3/Kg ; h_f = 1085.36 kJ/Kg ; h_{fg} = 1716.2 kJ/Kg, S_f = 2.7927 kJ/Kg K ; S_{fg} = 3.2802 kJ/Kg K ; u_f = 1080.39 u_{fg} = 1522 kJ/Kg.	10	L3	CO3
	b.	Define the following : i) Critical point ii) Triple point iii) Dryness fraction iv) Latent heat v) Saturated vapour.	10	L2	CO3

		OR			
Q.8	a.	Derive first and second Tds equations.	8	L1	CO3
	b.	A mass of air is initially at 260°C and 700 KPa and occupies 0.028 m^3. The air is expanded at a constant pressure to 0.084 m^3. A polytropic process with n = 1.5 if then carried out, followed by a constant temperature process which completes a cycle. All the processes are reversible . i) Sketch the cycle in P-V and T-S planes ii) Find the heat received and heat rejected in the cycle iii) Find the efficiency of the cycle.	12	L3	CO3
		Module – 5			
Q.9	a.	An engine working in the Otto cycle is supplied with air at 0.1 MPa, 35°C. The compression ratio is 8. Heat supplied is 2100 kJ/Kg. Calculate the maximum pressure and temperature of the cycle, the cycle efficiency and the mean effective pressure [for air, C_p = 1.005, C_v = 0.718 and R = 0.287 kJ/Kg K]	10	L3	CO3
	b.	With the help of P-V and T-S diagrams, derive an expression for the air standard efficiency of a diesel cycle.	10	L2	CO3
		OR			
Q.10	a.	Sketch and explain the flow diagram and corresponding T-S diagram of Reheat-Regenerative cycle. Write energy balance equation.	10	L2	CO3
	b.	Sketch and explain the flow diagram and corresponding T-S diagram and Ideal Regenerative Cycle and evaluate its efficiency.	10	L2	CO3

* * * * *