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Fourth Semester B.E./B.Tech. Degree Examination, June/July 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. M : Marks , L: Bloom's level , C: Course outcomes.

Module – 1				M	L	C																				
Q.1	a.	Define : i) Closed system ii) Open system iii) Isolated system iv) Intensive properties v) Extensive properties		10	L1	CO1																				
	b.	Establish the relationship between Celsius and Fahrenheit scales.		10	L2	CO1																				
OR																										
Q.2	a.	A system undergoes a process in which the pressure and volume are related by an equation of the form $pV^n = C$. Derive an expression for displacement work during this process.		10	L1	CO1																				
	b.	A spherical balloon of 0.5 m diameter contains air at a pressure of 500 kPa. The diameter increases to 0.55 m in a reversible process during which pressure is proportional to diameter. Determine the work done by the air during this process.		10	L2	CO1																				
Module – 2																										
Q.3	a.	State I law of thermodynamics. Explain classic paddle experiment with relevant sketches.		10	L2	CO2																				
	b.	Show that energy is a property of system.		10	L2	CO2																				
OR																										
Q.4	a.	Derive an expression for change in internal energy during adiabatic isentropic process with p-V diagram and prove that $pV^\gamma = C$ for the process.		10	L2	CO2																				
	b.	A piston and cylinder contain a fluid system which passes through a complete cycle of four processes. During a cycle, the sum of all heat transfers is -170 kJ. The system completes 100 cycles/min. Complete the following table and compute the net rate of work output in kW. <table><tr><td>Process</td><td>Q (kJ/min)</td><td>W(kJ/min)</td><td>ΔU(kJ/min)</td></tr><tr><td>a-b</td><td>0</td><td>2170</td><td></td></tr><tr><td>b-c</td><td>21000</td><td>0</td><td></td></tr><tr><td>c-d</td><td>-2100</td><td></td><td></td></tr><tr><td>d-a</td><td></td><td></td><td>-36600</td></tr></table>	Process	Q (kJ/min)	W(kJ/min)	ΔU (kJ/min)	a-b	0	2170		b-c	21000	0		c-d	-2100			d-a			-36600		10	L2	CO2
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1 of 2

Module – 3

Q.5	a.	Prove that the violation of Kelvin-Planck statement implies the violation of Clausius statement, for II law of thermodynamics.	10	L3	CO3
	b.	A cyclic heat engine operates between a source temperature of 800°C and a sink temperature of 30°C. What is the least rate of heat rejection per kW net output of the engine?	10	L3	CO3

OR

Q.6	a.	State and prove Clausius inequality.	10	L3	CO3
	b.	A heat engine absorbs 200 kJ/s of heat at 227°C and rejects heat at 27°C. Three separate cases of heat rejection are reported. i) 180 kJ/s heat rejected ii) 120 kJ/s heat rejected iii) 60 kJ/s heat rejected Classify each cycle	10	L3	CO3

Module – 4

Q.7	a.	Define : i) Critical point ii) Triple point iii) Dryness fraction iv) Pure substance v) Compressibility factor	10	L1	CO4
	b.	Find the enthalpy, specific volume and internal energy, if the pressure of steam is 50 bar and temperature is 443°C.	10	L4	CO4

OR

Q.8	a.	Derive and explain Maxwell's equation.	10	L1	CO4
	b.	Define and derive equation of state for a perfect gas.	10	L4	CO4

Module – 5

Q.9	a.	With the help of p-V and T-s diagram, derive an expression for air standard efficiency of Otto cycle.	10	L3	CO5
	b.	A Carnot engine working between 400°C and 40°C produces 130 kJ of work. Determine: i) The engine thermal efficiency ii) The heat added iii) The entropy change during heat rejection process	10	L4	CO5

OR

Q.10	a.	With the help of a neat schematic, p-V and T-s diagrams, derive an expression for efficiency of Rankine cycle.	10	L3	CO5
	b.	A Carnot cycle works on steam between the pressure limits of 7 MPa and 7 kPa. Determine thermal efficiency, turbine work and compression work per kg of steam.	10	L4	CO5
