Name: Enrolment No:	![UPES logo] UPES UNIVERSITY OF TOMORROW

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	How an open system is different from an adiabatic system?	4	CO1
Q 2	Schematically explain the difference between Nozzles and Diffusers?	4	CO2
Q 3	Write two two statements of the second law of thermodynamics.	4	CO3
Q 4	How process can be defined as reversible, irreversible or impossible based on entropy generation (S_{gen})?	4	CO4
Q 5	Write any two Maxwell relations.	4	CO4

SECTION B
(4Qx10M= 40 Marks)

Q 6	The properties of a closed system change following the relation between pressure and volume as PV = 3.0 where P is in bar V is in m^3. Calculate the work done when the pressure increases from 1.5 bar to 7.5 bar.	10	CO1
Q 7	5. A gas undergoes a thermodynamic cycle consisting of three processes: Process 1-2: constant volume, V = 0.028 m^3, U_2-U_1 = 26.4kJ Process 2-3: expansion with PV = constant, U_3= U_2 Process 3-1: constant pressure, P = 1.4 bar, W_{31} = -10.5 kJ There are no significant changes in kinetic or potential energy. (a) Sketch the cycle on a p-V diagram (b) Calculate the work done for the process 2-3 in kJ (c) Is this a Power Cycle or Refrigeration Cycle? Justify your answer.	10 (2+4+4)	CO2
Q 8	A refrigerator maintains the temperature of the freezer compartment at -5 C when the air surrounding the refrigerator is at 22 °C. The rate of	10	CO3

	heat transfer from the freezer compartment to the refrigerant is 8000 kJ/h and the power input required to operate the refrigerator is 3200 kJ/h. Determine if this refrigerator is working reversibly or irreversibly?		
Q 9	300 kJ/s of heat is supplied at a constant fixed temperature of 290°C to a heat engine. The heat rejection takes place at 8.5°C. The following results were obtained: (i) 215 kj/s are rejected (ii) 150 kj/s are rejected (iii) 75 kj/s are rejected Classify the results for a reversible or irreversible or impossible cycle (by applying Clausius inequality to the cycle or process).	10	CO4

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SECTION-C
(2Qx20M=40 Marks)

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Q 10	The data listed below are claimed for a power cycle operating between hot and cold reservoirs at 727°C and 27°C, respectively. For each case, determine whether the cycle operating reversibly, irreversibly, or is impossible. (a) Q_H = 600 kJ, W_{cycle} = 300 kJ, Q_C= 300 kJ (b) Q_H = 400 kJ, W_{cycle} = 280 kJ, Q_C= 120 kJ (c) Q_H = 700 kJ, W_{cycle} = 300 kJ, Q_C= 500 kJ (d) Q_H = 800 kJ, W_{cycle} = 600 kJ, Q_C= 200 kJ	20 (5+5+5+5)	CO3
Q 11	(a) Is throttling valve isenthalpic or isentropic device? Justify your answer. (b) 12 kg of air per minute is delivered by a centrifugal air compressor. The inlet and outlet conditions of air are V1 = 12 m/s, P1 = 1 bar, v1 = 0.5 m3/kg and V2 = 90 m/s, P2 = 8 bar, v2 = 0.14 m3/kg. The increase in enthalpy of air passing through the compressor is 150 kJ/kg and heat loss to the surroundings is 700 kJ/min. Find : (i) Motor power required to drive the compressor; (ii) Ratio of inlet to outlet pipe diameter. Assume that inlet and discharge lines are at the same level.	20 (8+6+6)	CO2