Name: **Enrolment No:**	

UPES

End Semester Examination, December 2023

Course: Thermodynamics and Heat Transfer **Semester: III**
Program: B.Tech Aerospace Engineering **Time : 03 hrs.**
Course Code: MECH 2022 **Max. Marks: 100**

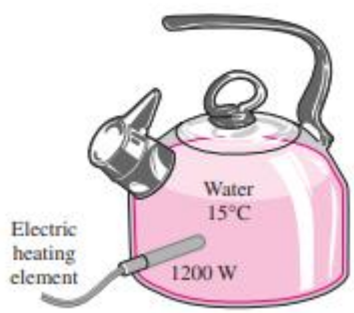
Instructions:
Gas tables are allowed to use in the examination.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	What is a quasistatic process in thermodynamics, and why is it considered an idealized process? Describe how a quasistatic process differs from a non-quasistatic or irreversible process.	**4**	**CO1**
Q 2	How does the air-standard cycle assume ideal gas behavior? What are the implications of this assumption? Discuss the relevance of assuming constant specific heats in the air-standard cycle.	**4**	**CO2**
Q 3	Discuss the role of entropy in the operation of heat engines. How does the increase in entropy relate to the efficiency of a heat engine?	**4**	**CO3**
Q 4	How does the First Law of Thermodynamics relate to energy balance in different thermodynamic processes? Discuss how the First Law is applied to analyze processes like adiabatic expansion or compression.	**4**	**CO1**
Q 5	Describe Fourier's Law of Heat Conduction and explain how it relates to the rate of heat transfer. What factors influence the rate of heat conduction through a material?	**4**	**CO2**

SECTION B
(4Qx10M= 40 Marks)

Q 6	Explain the differences between forced convection and natural convection, providing examples of each How do variations in fluid properties (such as viscosity, density, and specific heat) impact convective heat transfer?	**10**	**CO1**

Q 7	Derive Steady flow Energy Equation and apply the principle to the turbines and compressors, express equation in simplified form.	**10**	**CO3**
Q 8	A gas of 4 kg is contained within a piston cylinder machine. The gas undergoes a process for which $pV^{1.5}$ =constant. The initial pressure is 3 bar and the initial volume is 0.1 m^3, and the final volume is 0.2 m^3. The specific internal energy of the gas decreases by 4.6 kJ/kg. There are no significant change in KE and PE. Determine the net heat transfer for the process.	**10**	**CO2**
Q 9	1.2 kg of liquid water initially at 15 ^oC is to be heated to 95 ^oC in a teapot equipped with a 1200 W electric heating element inside. The teapot is 0.5 kg and has an average specific heat of 0.7 kJ/kg ^oC. Taking the specific heat of water to be 4.18 kJ/kg ^oC and disregarding any heat loss from the teapot, determine how long it will take for the water to be heated. 	**10**	**CO3**
SECTION-C **(2Qx20M=40 Marks)**			
Q 10	(a). What are the conditions necessary for a process to be reversible? Why are these conditions challenging to achieve in reality? How does the Carnot cycle illustrate the concept of reversible processes in thermodynamics? (b). An ice making plant produces ice at atmospheric pressure and at 0 ^oC from water. The mean temperature of the cooling water circulating through the condenser of the refrigerating machine is 18 ^oC. Evaluate the minimum electrical work in kWh required to produce 1 tonne of	**20**	**CO4**

	ice.(The enthalpy of fusion of ice at atmospheric pressure is 333.5 kJ/kg).		
Q11	A simple ideal Brayton cycle with air as the working fluid has a pressure ratio of 10. The air enters the compressor at 520 R and the turbine at 2000 R. Accounting for the variation of specific heats with temperature, determine (a) the air temperature at the compressor exit, (b) the back work ratio, and (c) the thermal efficiency.	**20**	**CO5**
	(OR) An ideal Otto cycle has a compression ratio of 8. At the beginning of the compression process, air is at 95 kPa and 27 ^{o}C, and 750 kJ/kg of heat is transferred to air during the constant-volume heat-addition process. Taking into account the variation of specific heats with temperature, determine (a) the pressure and temperature at the end of the heat- addition process, (b) the net work output, (c) the thermal efficiency, and (d) the mean effective pressure for the cycle.		