Name:

Enrolment No:

UPES

End Semester Examination, December 2023

Course: Thermodynamics and Heat Engines **Semester : III**

Program: B. Tech- Mechanical Engineering **Time : 03 hrs.**

Course Code: MEPD2006 **Max. Marks: 100**

Instructions: Use of STEAM TABLE is permitted.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Describe briefly different types of thermodynamic systems with suitable examples?	**4**	**CO1**
Q 2	Give the following statements of second law of thermodynamics. (i) Clausius statement (ii) Kelvin-Planck statement.	**4**	**CO1**
Q 3	The mechanical efficiency of a single-cylinder four-stroke engine is 80%. The brake power is estimated to be 100 kW. Calculate the indicated power and frictional power developed by the engine.	**4**	**CO3**
Q 4	Derive an expression for work done in a reversible adiabatic process.	**4**	**CO2**
Q 5	Draw and explain the indicator diagram of a 4-stroke petrol engine.	**4**	**CO2**
	SECTION B **(4Qx10M= 40 Marks)**		
Q 6	Derive an expression for efficiency of air standard Otto cycle.	**10**	**CO2**
Q 7	A turbine, operating under steady-flow conditions, receives 4500 kg of steam per hour. Steam enters the turbine at a velocity of 2800 m/min, an elevation of 5.5 m and a specific enthalpy of 2800 kJ/kg. It leaves the turbine at a velocity of 5600 m/min, an elevation of 1.5 m and a specific enthalpy of 2300 kJ/kg. Heat losses from the turbine to the surroundings amount to 16000 kJ/h. Determine the power output of the turbine.	**10**	**CO4**
Q 8	A mass of gas is compressed in a quasi-static process from 70 kPa, 0.1 m^3 to 0.4 MPa, 0.03 m^3. Assuming that the pressure and volume are related by PV^n =constant, find the work done by the gas system.	**10**	**CO3**

Q 9	Wet steam at 165 °C and dryness fraction of 0.75 is heated at a constant pressure until it becomes superheated vapour at 300 °C. Find the change in specific volume, enthalpy, and entropy. **OR** 4 Kg of steam at 6.0 bar pressure and dryness fraction of 0.5 is heated, so that it becomes (a) 0.95 dry (b) Dry & saturated (c) Superheated to 300 oC. Determine the net heat supplied in each case.	**10**	**CO3**
SECTION-C **(2Qx20M=40 Marks)**			
Q 10	A steam boiler generates steam at 30 bar, 300 °C at the rate of 2 kg/s. This steam is expanded isentropically in a turbine to a condenser pressure of 0.05 bar, condensed at constant pressure and pumped back to boiler. a) Find the heat supplied in the boiler per hour. b) Determine the quality of steam after expansion. c) What is the power generated by the turbine? d) Estimate the Ranking efficiency considering pump work.	**20**	**CO3**
Q 11	A gas engine operating on the ideal Otto cycle has a compression ratio of 6:1. The pressure and temperature at the commencement of compression are 1 bar and 27 °C. Heat added during the constant volume combustion process is 1170 kJ/kg. Determine the peak pressure and temperature, work output per kg of air and air-standard efficiency. Assume C_v =0.717 kJ/kg K and γ = 1.4 for air. **OR** In an engine working on Diesel cycle inlet pressure and temperature are 1 bar and 17 °C respectively. Pressure at the end of adiabatic compression is 35 bar. The ratio of expansion i.e. after constant pressure heat addition is 5. Calculate the heat addition, heat rejection and the efficiency of the cycle. Assume γ = 1.4, C_p = 1.004 kJ/kg K and C_v = 0.717 kJ/kg K.	**20** **20**	**CO4**