Name:

Enrolment No:

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2022

Course: Thermodynamics **Semester: III**
Program: B.Tech Mechanical **Time : 03 hrs.**
Course Code: MECH2043 **Max. Marks: 100**

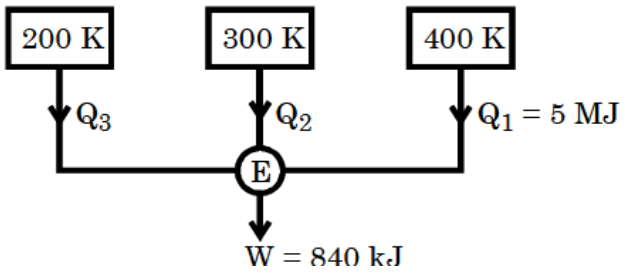
Instructions: Make suitable assumptions (if any needed)

SECTION A
(5Qx4M=20Marks)

S. No.	Question	Marks	CO
Q 1	Explain the basis of Mollier's Diagram. What purpose does it fetch?	**4**	**CO1**
Q 2	Explain the following terms (a) internal Energy (b) "can we replace a reversible path with set of zig-zag reversible paths"	**4**	**CO1**
Q 3	Explain the following (a) Entropy principle (b) Write the relation to find the entropy of superheated steam.	**4**	**CO1**
Q 4	Explain the term "Thermostatics"	**4**	**CO1**
Q 5	Comment on the practicability of Carnot cycle?	**4**	**CO1**

SECTION B
(4Qx10M= 40 Marks)

Q 6	Show that the efficiency of all reversible heat engines operating between the same temperature levels is the same.	**10**	**CO3**
Q 7	A reciprocating air compressor takes in 2 m3/min at 0.11 MPa, 20°C which it delivers at 1.5 MPa, 111°C to an aftercooler where the air is cooled at constant pressure to 25°C. The power absorbed by the compressor is 4.15 kW. Determine the heat transfer in (a) The compressor (b) The cooler State your assumptions	**10**	**CO3**
Q 8	Two reversible heat engines *A* and *B* are arranged in series, A rejecting heat directly to *B.* Engine *A* receives 200 kJ at a temperature of 421°C from a hot source, while engine *B* is in communication with a cold sink at a temperature of 4.4°C. If the work output of *A* is twice that of *B,* find (a) The intermediate temperature between *A* and *B;* (b) The efficiency of each engine; (c) The heat rejected to the cold sink.	**10**	**CO3**

Q 9	Dry saturated steam at a pressure of 10 bar is expanded isentropically in a nozzle to pressure of 0.7 bar. With the help of Mollier's diagram, find the velocity and dryness fraction of the steam issuing from the nozzle. **OR** 680 kg of fish at 5°C are to be frozen and stored at -12°C. The specific heat of fish above freezing point is 3.182, and below freezing point it is 1.717 kJ/kgK. The freezing point is -2°C, and the latent heat of fusion is 234.5 kJ/kg. How much heat must be removed to cool the fish, and what percent of this is latent heat?	**10**	**CO4**
SECTION-C (2Qx20M=40 Marks)			
Q 10	(a) Give the criteria of reversibility, irreversibility and impossibility of a thermodynamic cycle. (b) Calculate the entropy change of the universe as a result of the following processes: (a) A copper block of 600 g mass and with *Cp* of 150 J/K at 100°C is placed in a lake at 8°C. (b) Two such blocks, at 100 and 0°C are joined together.	**20**	**CO4**
Q 11	A reversible engine, as shown in Figure during a cycle of operations draws 5 MJ from the 400 K reservoir and does 840 kJ of work. Find the amount and direction of heat interaction with other reservoirs.  OR (a) Compare the efficiency of a Carnot cycle and Rankine cycle in steam and comment the suitability of Carnot cycle in steam? (b) In an Air standard Diesel cycle the compression ratio is 16, and the compression begins at 35 °C, 0.1 MPa, the maximum temperature of the cycle is 1200°C. Find (a) the temperature and pressure at the cardinal points of the cycle, (b) the heat supplied per kg of air, (c) the work done per kg of air (d) the cycle efficiency, and (e) the mean effective pressure of the cycle.	**20**	**CO2**