PRESIDENCY UNIVERSITY
BENGALURU

SET B

SCHOOL OF ENGINEERING
END TERM EXAMINATION - JAN 2024

Semester : Semester III - 2022
Course Code : MEC4001
Course Name : Basic Thermodynamics
Program : B.Tech.

Date : 10-JAN-2024
Time : 9:30AM - 12:30 PM
Max Marks : 100
Weightage : 50%

Instructions:
(i) Read all questions carefully and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and non-programmable calculator are permitted.
(iv) Do not write any information on the question paper other than Roll Number.

PART A

ANSWER ALL THE QUESTIONS   **4 X 5M = 20M**

1. Define heat and work with reference to thermodynamic point of view and also the sign convention of heat and work.

                                                        (CO1) [Knowledge]

2. Define Open system, Closed system and Isolated system with and practical example in each case.

                                                        (CO2) [Knowledge]

3. A ideal gas (specific heat constant pressure 1000 J/kg.K) enters and leaves a gas turbine with the same velocity. The temperatures of the gas at turbine entry and exit are 1100 K and 400 K. respectively. The power produced is 4.6 MW and heat escapes at the rate of 300 kJ/s through the turbine casing. Find the mass flow rate of the gas (in kg/s) through the turbine. Also draw diagram showing inlet and outlet points clearly.

                                                        (CO1) [Knowledge]

4. Write Steady Flow Energy Equation for turbine assuming turbine to be adiabatic. Also draw diagram showing Inlet and Outlet points.

                                                        (CO2) [Knowledge]

PART B

ANSWER ALL THE QUESTIONS   **5 X 10M = 50M**

5. Derive the equation for entropy change for ideal gas. m=mass , R= characteristic gas constant, Cp= Specific heat at constant Pressure.

$$S_2 - S_1 = mC_p ln\frac{T_2}{T_1} - mRln\frac{P_2}{P_1}$$

Subscript 1 is initial state and 2 is final state.

                                                        (CO3) [Comprehension]

6. What will be entropy change for a system when it undergoes reversible heat addition, reversible heat rejection and zero heat transfer. Prove your answer with help of equation.

(CO3) [Comprehension]

7. Prove that the slope of constant volume line is greater than slope of constant pressure line on Temperature Entropy diagram. (First derive the slope of both lines).

(CO4) [Comprehension]

8. Define Heat engine, Heat Pump and Refrigerator with line diagram. What is relationship between heat pump and refrigerator.

(CO4) [Comprehension]

9. Explain sub-cooled region, wet region and super heated region on temperature(T) entropy(S) axis. Define each region with help of T-S Diagram.

(CO5) [Comprehension]

PART C

ANSWER ALL THE QUESTIONS   2 X 15M = 30M

10. a) One kg of air (R=287J/kgK) undergoes an irreversible process between equilibrium state 1(20 degree C,0.9 m^3) and equilibrium state 2(20 degreeC,0.6 m^3). Find the change in entropy (s2−s1 (in J/kgK))

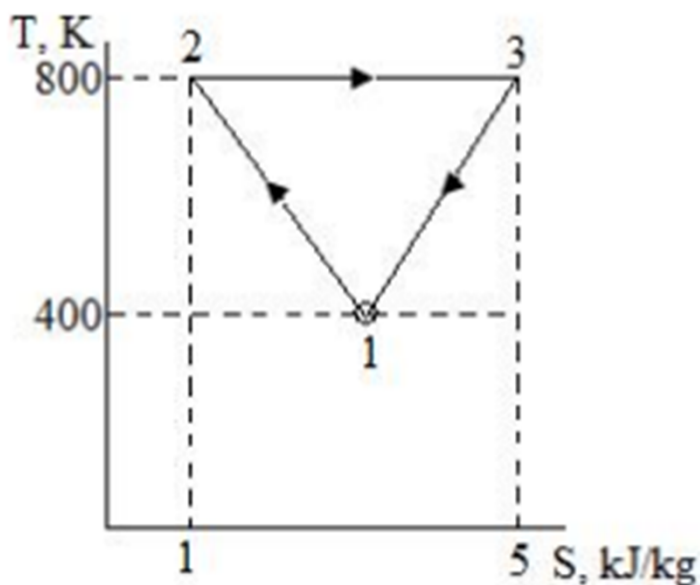b) Find the thermal efficiency of the hypothetical heat engine cycle shown in the fig. b

fig. b

(CO3) [Application]

11. **a)** A vessel of volume 1.0 m^3 contains a mixture of liquid water and steam in equilibrium at 1.0 bar. Given that 90% of the volume is occupied by the steam, find the dryness fraction of the mixture. Assume at 1.0 bar, vf = 0.001 m^3 /kg and vg = 1.7 m^3 /kg. Where vf= specific volume of saturated liquid, vg= specific volume of saturated vapour. Also plot temperature entropy diagram showing the pressure line and the point showing dryness fraction.

b) A mass of 5 kg of liquid water is cooled from 100°C to 20°C. The ambient temperature is 25 degree celcius. The specific heat of water is 4.2 kJ/kg-C. Find.....
   i) Entropy change of water
   ii) Entropy change of surrounding.
   iii) Entropy change of Universe

(CO4) [Application]