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# PRESIDENCY UNIVERSITY
# BENGALURU

## SCHOOL OF ENGINEERING
## END TERM EXAMINATION - JAN 2023

**Semester :** Semester III - 2021
**Course Code :** MEC4001
**Course Name :** Sem III - MEC4001 - Basic Thermodynamics
**Program :** B.Tech. Mechanical Engineering

**Date :** 16-JAN-2023
**Time :** 1.00PM - 4.00PM
**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.*

### PART A

**ANSWER ALL THE TEN QUESTIONS** **10 X 3 = 30M**

**1.** Explain Open System, Closed System and Isolated System.
(CO1) [Knowledge]

**2.** Define Adiabatic Process. Write the expression for work done in adiabatic expansion process.You can assume 1 as initial point and 2 as final point.
(CO1) [Knowledge]

**3.** Why specific heat at constant pressure(Cp) is greater than specific heat at constant volume(Cv) for any gas.
(CO2) [Knowledge]

**4.** Define isothermal process and isobaric process with an example.
(CO2) [Knowledge]

**5.** What is Clausius Inequality. Write down the equation for clausius inequality.
(CO3) [Knowledge]

**6.** Explain Kelvin Plank Statement for Second Law of Thermodynamics. What is the outcome of Kelvin Plank Statement.
(CO3) [Knowledge]

**7.** Explain Clausius Statement of second law of thermodynamics. What is the outcome of Clausius Statement.
(CO3) [Knowledge]

**8.** A rigid container of volume 0.5 $m^3$ contains 1 kg of water at 120 degree celcius. At 120 degree celcius, volume at saturated liquid(vf)= 0.00106 $m^3$/kg and volume at saturated vapour(vg)= 0.8908 $m^3$/kg. Based on the data given what is the state of water.
(CO4) [Knowledge]

**9.** Define Latent heat and sensible heat.
(CO4) [Knowledge]

**10.** Define Saturation Temperature and Saturation Pressure.
(CO4) [Knowledge]

## PART B

**ANSWER ALL THE TWO QUESTIONS** **2 X 10 = 20M**

**11.** 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]

**12.** 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]

## PART C

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

**13.** 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 1100K and 400K. respectively. The power produced is 4.6MW and heat escapes at the rate of 300kJ/s through the turbine casing. Find the mass flow rate of the gas (in kg/s) through the turbine. Neglect changes in potential energy.

(CO2) [Application]

**14.** Steam at initial enthalpy of 100 kJ/kg and inlet velocity of 100 m/s , enters a insulated horizontal nozzle. It leaves the nozzle at 200 m/s. Find the enthalpy of steam at exit (in kilowatt). Consider mass flow rate of steam to be 5 kg/s.

(CO2) [Application]

**15.** An irreversible heat engine extracts heat from a high temperature source at a rate of 100 kW and rejects heat to a sink at a rate of 50 kW. The entire work output of the heat engine is used to drive a reversible heat pump operating between a set of independent isothermal heat reservoirs at 17°C and 75°C. Calculate the rate (in kW) at which the heat pump delivers heat to its high temperature sink.

(CO3) [Application]

**16.** A mass of 5 kg of liquid water is cooled from 100 degree celcius to 30 degree celcius. The ambient temperature is 30 degree celcius. Consider water to be system and all other to be surrounding. Take specific heat of water to be 4.2 kJ/kg-K.
Caculate-a) Entropy change of system
b)Entropy change of surrounding
c) Entropy change of universe.

(CO3) [Application]

**17.** A tank of volume 0.05 $m^3$ contains a mixture of saturated water and saturated steam at 200°C. The mass of the liquid present is 8 kg. Find the entropy (in kJ/kgK) of the mixture.
Property data for saturated steam and water are:
At 200ºC [Psat = 1.5538 MPa], vf = 0.001157 $m^3$/kg, vg = 0.12736 $m^3$/kg, sfg = 4.1014 kJ/kgK, sf = 2.3309 kJ/kgK

(CO4) [Application]

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