(Following Paper ID and Roll No. to be filled in your Answer Book)

Paper ID : 166702 Roll No. | | | | | | | | | | |

B.Tech.

(SEM. III) THEORY EXAM. 2015-16

THEROMODYNAMICS

[Time : 3 hours] [Maximum Marks : 100]

SECTION - A

1. Attempt **all** parts. carry equal marks. Write answer of each part in short. (2x10=20)

   (a) What is concept of continuum ?

   (b) Explain Amagat's Law.

   (c) Discuss the significance of Clausius inequality.

   (d) Why does free expansion has zero work transfer ?

   (e) Energy can be conserved but not entropy. Explain .

   (f) A heat engine receives heat at a rate of 500 kW from a source at 1200 K, rejects waste heat at 300 K, and in the process delivers a power of 180kW. Determine :

(i) Reversible Power

(ii) Irreversibilty rate

(g) In a refrigerator, the food preservation temprature is -5°C, while the atomospheric temperature is 25°C. The cooling load is 5k W. Determine the minimum power required to operate the unit.

(h) Why should specific heat not be defined in terms of heat transfer ?

(i) What is meant by degree of superheat and degree of subcooling?

(j) What are the limitations of 1st law of thermodynamics ?

SECTION-B

Attempt **any five** questions from this section. (10x5=50)

2. A reversible heat engine oprates between two reservoirs at temperature of 600°C and 40°C. The engine drives a reversible refrigerator which operates between reservoirs at temperature of 40°C & -20°C. The heat transfer to the engine is 2 MJ and the net work output of the combined engine and the refrigerator plant is 360 kJ. Find the heat transfer to the refrigerant and the net heat transfer to the reservoir at 40°C. Also find these values if the efficiency of the heat engine and COP of

the refrigerator are each 40% of their maximum possible values.

3. A rigid closed tank of volume $3m^3$ contains 5 kg of wet steam at a pressure of 200kPa. The tank is heated until the steam becomes dry saturated. Determine the final pressure and the heat transfer to the tank.

4. Comment on the statement; Heat having high entropy has a low possibility of conversion into work, whereas heat having low entropy has a possibility of conversion into work, show that change in entropy of an irreversible process is always positive.

5. Two blocks of metal, each having a mass of 10 kg and a specific heat of 0.4 kJ/kg K, are at a temperature of 40°C. A reversible refrigerator receives heat from one block and rejects heat to the other. Calculate the work required to cause a temperature difference of 100°C between the two blocks.

6. Establish the equivalence of Kelvin Planck & Clausius Statement Show that efficiency of a reversible heat engine operating between the same temperature limits is same.

7. Name the various methods to determine the dryness fraction of steam. Explain combined separating and throttling calorimeter.

8. What is steady flow process ? Write the steady flow energy equation for a single stream entering and single stream leaving a control volume. Explain the control volume technique in a variable flow process.

9. A Carnot engine operating between temperatures T_1 & T_2 with efficiency η_1 and other Carnot engine operates between temperatures T_2 & T_3 with efficiency η_2. Show that the carnot engine operating between temperatures T_1 and T_3 will have efficiency $(\eta_1 + \eta_2 - \eta_1 \eta_2)$

SECTION - C

Attempt **any two** questions from this section. (15X2=30)

10. Steam expands isentropically in a nozzle from 1 MPa, 250°C to 10 kPa. The steam flow rate is 1 kg/s. Find the velocity of steam at the exit from the nozzle, and the exit area of the nozzle. Neglect the velocity of steam at the inlet to the nozzle. The exhaust steam from the nozzle flows into a condenser and flows out as saturated water. The cooling water enters the condenser at 25°C and leaves at 35°C Determine the mass flow rate of cooling water.

11. All adiabatic porcess may not be isentropic, but all isentropic porcess are adiabatic. Justify an insulated 0.75 kg copper calorimeter can containing 0.2 kg water is in equilibrium at a temperature of 20°C. An experimenter now places 0.05 kg of ice at 0°C in the calorimeter and encloses the latter with a heat insulating shield.

(a) When all the ice has melted and equilibrium has been reached, what will be the temperature of water and the can ? The specific heat of copper is 0.418 kJ/kg K and the latent heat of fusion of ice is 333 kJ/kg.

(b) Compute the entropy increase of the universe resulting from the process.

(c) What will be the minimum work needed by a stirrer to bring back the temperature of water to 20°C ?

12. Define thermal efficiency, mechanical efficiency, volumetric efficiency, Brake power, Indicated power of and IC engine and explain the working of the stoke SI engine with neat sketch and differentiate between two stroke and four stroke SI engine.

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