Hall Ticket No | | | | | | | | | | | Question Paper Code: AME003

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

B.Tech IV Semester End Examinations (Regular / Supplementary) - May, 2019

Regulation: IARE – R16

THERMODYNAMICS

Time: 3 Hours **(AE)** **Max Marks: 70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1. (a) Define the following terms:
   i. Thermodynamic equilibrium
   ii. Reversible process and irreversible process
   iii. Homogeneous and heterogeneous system
   iv. Causes of irreversibility **[7M]**

   (b) A piston cylinder device operates 1kg of fluid at 20atm pressure with initial volume is 0.04m^3. Fluid is allowed to expand reversibly following $pV^{1.45}$=C, so that the volume becomes double. The fluid is cooled at constant pressure until the piston comes back. Determine the work done in each process. **[7M]**

2. (a) Derive the steady flow energy equation and hence apply the same for the nozzle and determine the exit velocity of nozzle. **[7M]**

   (b) A nozzle is a device for increasing the velocity of a steadily flowing stream. At the inlet to a certain nozzle, the enthalpy of the fluid passing is 3000 kJ/kg and the velocity is 60 m/s. At the discharge end, the enthalpy is 2762 kJ/kg. The nozzle is horizontal and there is negligible heat loss from it.
   i. Find the velocity at exit from the nozzle.
   ii. If the inlet area is 0.1 m^2 and the specific volume at inlet is 0.187 m^3/kg, find the mass flow rate. **[7M]**

UNIT – II

3. (a) Explain with the help of P-V diagram the different process in a Carnot cycle. **[7M]**

   (b) Ten Kgs of water at 20^{0}C is converted into ice at -10^{0}C at constant atmosphere pressure. Assuming the specific heat of liquid water to remain constant at 4.2 kJ/kg.K and ice to be half of this value and taken the latent heat of fusion of ice at 0^{0}C to be 335KJ/Kg . Calculate the total entopy change of the systems **[7M]**

4. (a) Discuss Clausius statement? State and prove Clausius inequality. **[7M]**

   (b) A heat engine is supplied with 2512kJ/min of heat at 650^0C. Heat rejection takes place at 100^0C. Distinguish which of the following heat rejection represent a reversible, irreversible or impossible result.

   i.867 kJ/min

   ii.1015 kJ/min

   iii. 1494 kJ/min **[7M]**

UNIT – III

5. (a) Why can not a throttling calorimeter measure the quality, if the steam is wet? Explain how is the quality been measured? **[7M]**

   (b) A large insulated vessel is divided in to two chambers. One is containing 5kg of dry saturated steam at 0.2MPa and other 10kg of steam, 0.8quality at 0.5MPa. If the partition between the chambers is removed and the steam is mixed thoroughly and allow to settle. Determine the final pressure steam quality and entropy change in the process? **[7M]**

6. (a) Define specific heat and why there are two types of specific heats. **[7M]**

   (b) The volume of a high altitude chamber is $40m^3$.It is put into operation by reducing pressure from 1bar to 0.4bar and temperature from 25^0C to 5^0C. How many kg of air must be removed from the chamber during the process. **[7M]**

UNIT – IV

7. (a) Define the following terms

   i. Partial pressure

   ii. Mole fraction

   iii. Mass fraction **[7M]**

   (b) A gas mixture contains 1kg 0_2 and 3.5 Kg N_2. The pressure and temperature of the mixture are 1 bar and 27^0C. Determine

   i. Mass fraction and mole fraction of each consistent

   ii. Average molecular weight of the mixture

   iii. Partial pressure of the constituents **[7M]**

8. (a) Describe the terms of atmospheric air like dry-bulb temperature, wet-bulb temperature, humidity, relative humidity and degree of saturation **[7M]**

   (b) Atmospheric air at 1.0132 bar has dry bulb temperrature of 32^0C and a wet bulb temperature of 26^0C. Compute partial pressure of the water vapor, specific humidity, dew point temperature and relative humidity? **[7M]**

UNIT – V

9. (a) What is thermal efficiency of diesel cycle and deduce the equation for it. **[7M]**

   (b) The compression ratio in a diesel cycle is 14 and the cut-off occurs at 10% of the stroke. Determine the cut-off ratio and thermal efficiency of the cycle. **[7M]**

10. (a) Deduse an equation for performance of air refrigeration using Bell Coleman cycle **[7M]**

    (b) Show that for same compression ratio and same heat rejection $\eta_{otto} > \eta_{dual} > \eta_{diesel}$. **[7M]**

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