R16

Code No: 133BX

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech II Year I Semester Examinations, December - 2019

THERMODYNAMICS

(Common to ME, AE, MSNT)

Time: 3 Hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit.
Each question carries 10 marks and may have a, b, c as sub questions.

PART- A

(25 Marks)

1.a) What do you mean by a quasi static process? [2]
b) What are various types of properties? Explain. [3]
c) Write down the applications of SFEE. Derive expression for work done by the turbine. [2]
d) Derive the expression for exit velocity from the nozzle. [3]
e) Write the Clausius-Clapeyron equation and its significance. [2]
f) Calculate specific enthalpy, specific volume and density of 1 kg of steam at a pressure of 1.9 MPa, having a dryness fraction 0.85. [3]
g) Write the Carrier's equation and its significance. [2]
h) Discuss Daltons law of partial pressure. [3]
i) Compare Otto, Diesel and Dual cycles for given compression ratio. [2]
j) Draw p-v and T-s diagrams of Lenoir cycle. [3]

PART-B

(50 Marks)

2.a) What do you understand by macroscopic and microscopic view points?
b) How does free expansion have zero work transfer?
c) Show that work is a path function not a property. [3+3+4]

OR

3.a) What is a irreversible process? Explain the causes of irreversible process.
b) What is the qualitative difference between heat and work? Why are heat and work not completely interchangeable forms of energy?
c) What do you understand by path function and point function? What are exact and inexact differentials? [3+3+4]

4.a) Derive Clausius inequality and explain its significance.
b) Discuss about Third Law of Thermodynamics. [6+4]

OR

5. An inventor claims to have developed an engine that takes in 105 MJ at a temperature of 400K, rejects 42 MJ at a temperature of 200 K, and delivers 15 kWh of mechanical work. Listing out all the reasons, suggest your advice inventing money to put this engine in the market. [10]

6. A 3 MPa steam received from a boiler is charged to a throttling calorimeter where its pressure and temperature are found to be 1 bar and 146^0 C, respectively. Determine the quality of the boiler steam. [10]

OR

7. The following data were obtained in a test on a combined separating and throttling calorimeter: Pressure of steam sample =12 bar, pressure of steam at exit = 1 bar, temperature of steam at the exit $=150^0$C, discharge from separating calorimeter = 0.5 kg/min, discharge from throttling calorimeter =10kg /min. Determine the dryness fraction of the sample steam. [10]

8. A system of volume V contains a mass m of gas at pressure P and temperature T. The macroscopic properties of the system obey the following relationship $(P+a/V^2)(V-b)=mRT$, where a, b, R are constants obtain an expression for the displacement work done by the system during a constant temperature expansion from volume V_1 to V_2. Calculate the work done by a system which contains 10 kg of this gas expanding from $1m^3$ to $8\ m^3$ at a temperature of 300 K. Use the values
$a = 15.7 \times 10\ Nm^4$,
$b = 1.07 \times 10^{-2}\ m^3$ and R = 0.278 KJ/kg-K [10]

OR

9. A vessel of $2m^3$ capacity contains oxygen at 10 bar and 60^0C. The vessel is connected to another vessel of $4\ m^3$ capacity containing carbon monoxide at 1.5 bar and 25^0C.A connecting valve is opened and the gases mix adiabatically. Calculate:
a) The final pressure and temperature of the mixture
b) Change of entropy of the oxygen.
Take for oxygen $C_v = 21.07$ kJ/Mol-K
For carbon monoxide $C_v = 20.86$ kJ/Mol-K [10]

10.a) Draw p-v and T-s plots of Diesel cycle and explain various processes constituting the cycle.

b) Derive the expressions for efficiency and mean effective pressure of Diesel cycle. [5+5]

OR

11. An ammonia vapour compression refrigerator operates with evaporator pressure of 3.5 bar and condenser pressure of 15 bar. Calculate ideal and actual COP also calculate the mass flow rate per kW of refrigeration assuming that dry saturated vapour is delivered by the compressor and liquid after condensation is sub cooled to 20^0C. [10]

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