Code No: 133BX **R16**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech II Year I Semester Examinations, May/June - 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 is reversible process? [2]
b) What are exact and inexact differentials? [3]
c) What is a steady flow process? [2]
d) Why is the performance of a heat pump or a refrigerator not measured in terms of thermal efficiency, but in terms of COP? [3]
e) Draw P-V diagram for water and a pure substance other than water. [2]
f) What is the difference between critical point and triple point? [3]
g) Define Dry bulb temperature and wet bulb temperature. [2]
h) Define mole fraction and mass fraction. [3]
i) Draw the P-V diagram of Lenoir cycle. [2]
j) Draw the P-V and T-S plots of Otto cycle. [3]

PART-B

(50 Marks)

2.a) Show that heat is a path function and not a property.
b) A new scale N of temperature is divided in such a way that the freezing point of ice is 100^0N and the boiling point is 400^0N. What is the temperature reading on this new scale when the temperature is 150^0C? At what temperature both the Celsius and the new scale reading would be the same? [5+5]

OR

3.a) What is a constant volume gas thermometer? Why is it preferred to a constant pressure gas thermometer?
b) A piston-cylinder device operates 1 kg of fluid at 20 atm. Pressure. The initial volume is 0.04 m^3. The fluid is allowed to expand reversibly following a process $pV^{1.4}$ = constant so that the volume becomes double. The fluid is then cooled at a constant pressure until the piston comes back to the original position. Keeping the piston unaltered, heat is added reversibly to restore it to the initial pressure. Calculate the work done in the cycle. [5+5]

4.a) Prove that the COP of the reversible refrigerator operating between two given temperatures is the maximum.
b) Water is heated at a constant pressure of 0.7 MPa. The boiling point is 164.97^0C. The initial temperature of water is 0^0C. The latent heat of evaporation is 2066.3 kJ/kg. Find the increase of entropy of water if the final temperature is steam. [5+5]

OR

5. A reversible heat engine operates between two reservoirs at temperatures of 600^0C and 40^0C. The engine drives a reversible refrigerator which operates between reservoirs at temperatures of 40^0C and -20^0C. The heat transfer to the engine is 2000 kJ and the network output of the combined engine- refrigerator plant is 360 kJ.
a) Evaluate the heat transfer to the refrigerant and the net heat transfer to the reservoir at 40^0C.
b) Reconsider (i) given that the efficiency of the heat engine and the COP of the refrigerator are each 40% of their maximum possible value. [10]

6.a) Explain the free expansion process.
b) A rigid close tank of volume $3m^3$ contains 5 kg of wet steam at a pressure of 200 kPa. The tank is heated until the steam becomes dry saturated. Determine final pressure and heat transfer to the tank. [5+5]

OR

7.a) Write short notes on "Mollier diagram". Why do isobars on the Mollier Diagram diverge from one another?
b) A pressure cooker holding 2 kg of steam at 5 bar and 90% dry is being cooled slowly. What quantity of heat has to be extracted so as to reduce the steam quality down to 60%? Also calculate the pressure and temperature of the steam that remains in the pressure cooker after the heat rejection. [5+5]

8.a) Discuss why does the enthalpy of air-vapour mixture remains constant during an adiabatic saturation process.
b) A mixture of hydrogen (H_2) and oxygen (O_2) is to be made so that the ratio of H_2 to O_2 is 2:1 by volume respectively. Calculate i) the mass of O_2 required ii) volume of the container. [5+5]

OR

9.a) Explain Daltons law of partial pressures.
b) Air at 20^0C, 40% RH is mixed adiabatically with air at 40^0C, 40% RH in the ratio of 1 kg of former with 2 kg of the latter (on dry basis). Find the final condition of air. [5+5]

10. Explain the working of Bell coleman cycle and derive the expression for COP. [10]

OR

11. Explain the Diesel cycle with the help of P-V and T-S diagrams. Derive the expression for air standard efficiency mean effective pressure. [10]

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