Code No: 123AB **R15**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech II Year I Semester Examinations, September - 2021
THERMODYNAMICS
(Common to ME, AE)

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

Answer any five questions
All questions carry equal marks
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1.a) Explain Joule's experiment to prove the first law of thermodynamics and derive the equation for the process.
b) The readings t_A and t_B of two centigrade thermometers A and B, agree at the ice point (0^0C) and the steam point (100 ^{0}C), but elsewhere are related by the equation given as $t_A = l + mt_B + nt_B^2$ where l, m and n are constants. When both thermometers are immersed in a well stirred oil bath, A registers 51 ^{0}C while B registers 50^{0}C, then determine (i) reading on B when A reads 25^{0}C and (ii) which thermometer is correct. [7+8]

2.a) What are different causes for the irreversibilities in a system, process and for a cycle? Explain.
b) Steam enters a nozzle at a pressure of 7 bar and 205 ^{0}C. Initial enthalpy being 2850 kJ/kg and leaves at a pressure of 1.5 bar. The initial velocity of steam at the entrance is 40 m/s and the exit velocity from the nozzle is 700 m/s. The mass flow rate through the nozzle is 1400 kg/h. The heat loss from the nozzle is 11705 kJ/h. Determine the final enthalpy of steam and the nozzle exit area, if the specific volume is 1.24 m^3/ kg. [7+8]

3.a) Derive the equation for the estimation of available energy for the steady flow process and explain the importance of each term.
b) A reversible heat engine operating between the thermal reservoirs at 900 K and 300 K is used to drive a reversible refrigerator for which the temperature limits are 300 K and 250 K. The engine absorbs 1800 kJ of energy as heat from the reservoir at 900 K and the net output from the engine refrigerator system is 360 kJ. Make calculations for the heat extracted from the refrigerator cabinet and the net heat rejected to the reservoir at 300 K. [7+8]

4.a) From the Kelvin Planck statement of second law of thermodynamics explain PMM2.
b) Air at 90^{0}C and 0.9 MPa is having 1.28 kg is expanding adiabatically in a closed system until its volume is doubled and its temperature becomes equal to that of the surroundings which are at 20^{0}C and 103 kPa. Calculate the change in entropy, maximum work and change in availability. [7+8]

5.a) What is the need of compressibility factor chart? How is it being prepared based on Vander Waal's equation of state? Explain.
b) Steam which is initially at 420 ^{0}C and 8 MN/m^2 is expanding isentropically to a pressure of 1.9 MN/m^2. It is then reheated at constant pressure it has a temperature of 300 ^{0}C. It is isentropically further expanded to a pressure of 140 kN/m^2 Calculate the condition of steam after isentropic expansion, heat transfer per kg of steam to carry out at constant pressure process. [7+8]

6.a) What is dryness fraction? Explain the method to measure the dryness fraction experimentally.

b) 4 kg of air at 7.29 bar absolute and 88^0C passes through a reversible non–flow polytropic process represented by $PV^{1.1}$ = constant till the pressure falls to 1.49 bar. Find (i) The final temperature, specific volume and change in entropy, (ii) Work and heat transfer, (iii) What will be the answers if the process could have been irreversible and adiabatic between the same end states? [7+8]

7.a) Differentiate between specific humidity and relative humidity of moist air.

b) 4 kg of CO_2 at 50 ^0C and 1.4 bar are mixed with 8 kg of nitrogen at 150 ^0C and 1 bar to form a mixture at a final pressure of 0.7 bar. The process occurs adiabatically in a steady flow apparatus. Then calculate (i) the final temperature of mixture and (ii) change in entropy. [7+8]

8.a) Draw the line diagram of vapour compression refrigeration cycle and derive the equation for the COP of the cycle.

b) In an air standard Otto cycle the compression ratio is 7, and compression begins at 35 ^0C, 0.1MPa. The maximum temperature of the cycle is 1100 ^0C. Find (i) The temperature and pressure at the cardinal points of the cycle, (ii) The heat supplied per kg of air, (iii) The work done per kg of air, (iv) The cycle efficiency and (v) The mean effective pressure of the cycle. [7+8]

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