Code No: 113AB **R13**

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech II Year I Semester Examinations, December-2014

THERMODYNAMICS

(Common to ME, AE, AME, 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 quasi static process? Explain. [2M]
b) Differentiate between point function and path function. [3M]
c) What is the principle of increase of entropy? [2M]
d) What is mechanical reservoir? Explain the significance. [3M]
e) How to estimate the critical point conditions of a pure substance? [2M]
f) Discuss the importance of Claussius Clayperon equation. [3M]
g) State and explain Avagadro's law of additive volumes of ideal gas mixtures. [2M]
h) Define and explain adiabatic saturation. [3M]
i) Draw p-v and T-s diagrams of dual combustion cycle. [2M]
j) Define and explain coefficient of performance of refrigeration cycles. [3M]

Part - B (50 Marks)

2.a) Describe the functionality of a thermocouple and explain with a simple diagram.
b) A rigid insulated tank is initially evacuated is connected through a valve to a supply line that carries steam at 1 MPa and 300^0C. Now the valve is opened, and steam is allowed to flow slowly into the tank until the pressure reaches to 1 MPa, at which valve is closed. Determine final temperature of steam in tank.

OR

3.a) Derive the steady flow energy equation based on first law applied to a flow process and discuss the salient features.
b) Air flows steadily at the rate of 0.2 kg/s through an air compressor, entering at 6 m/s with a pressure of 1.0 bar and a specific volume of 0.9 m^3/kg and leaving at 4.8 m/s with a pressure of 8.9 bar and specific volume of 0.09 m^3/kg. The internal energy of the air leaving is 67 kJ/kg greater than that of the air entering. Cooling water in a Jacket surrounding the cylinder absorbs heat from the air at the rate of 100 W. Calculate the power required to drive the compressor.

4.a) What are the major limitations of first law of thermodynamics? How to overcome these limitations?
b) Water at 150 kPa and 10^0C enters a mixing chamber at a rate of 136 kg/min where it is mixed steadily with steam entering at 140 kPa and 115^0C. The mixture leaves the chamber at 140 kPa and 55^0C and heat loss to the surrounding air at 22^0C at a rate of 190kJ/min. Neglecting KE and PE, determine the entropy generation, available energy and irreversibility.

OR

5.a) Derive the Maxwell's relations, and obtain Mayer's relation. Discuss salient features from the relation.
b) A mass of 0.25 kg of air in a closed system expands from 2 bar and 60^0C to 1 bar and 40^0C, while receiving 1.05 kJ of heat from a reservoir at 100^0C. The surrounding atmosphere is at 0.95 bar and 27^0C. Determine the maximum useful work.

6.a) Explain the free expansion process along with the importance of this process.

b) Define real gas and how it differs from the ideal gas, and suggest a suitable method for the calculation of constants in the Vander waal's equation?

OR

7.a) Draw p-v-T surface of pure substances water and CO_2 and discuss the comparisons.

b) Determine the pressure of saturated steam at 40^0C if at 35^0C the pressure is 5.628 kPa, the enthalpy of vaporization is 2418.6 kJ/kg and the specific volume is 25.22 m^3/kg. The enthalpy of vaporization is essentially constant over this temperature range? Use Claussius Clayperon equation.

8.a) State and explain Dalton's law partial pressure and prove the statement mathematically.

b) 10 m^3/min of dry air at 32 ^0C fixed with a stream of hydrogen at 127 ^0C to form a mixed stream at 47 ^0C and 1 bar. The mixing occurs adiabatically and at steady state. Determine (i) the mass flow rates of the dry air and hydrogen, in kg/min, (ii) the mole fractions of the dry air and hydrogen in the existing mixture.

OR

9.a) Differentiate among dry bulb temperature, wet bulb temperature and dew point temperature.

b) Explain the method to draw the psychometric chart and discuss the important functions of the chart.

10.a) Compare Otto, diesel and dual combustion cycles based on same max pressure and temperature.

b) The compression ratio of an ideal dual cycle is 15 air is at 101 kPa and 22^0 C at the beginning of the compression process and at 2000 K at the end of the heat addition process. Heat transfer to air takes place partly at constant volume and partly at constant pressure and it amounts to 1000 kJ/kg assuming constant specific heat for air determine (i) the fraction of heat transferred at constant volume (ii) The thermal efficiency of cycle.

OR

11.a) Draw the simple along with thermodynamic diagrams of Bell Coleman cycle and derive the equation for COP of the system under ideal conditions.

b) How does the vapour compression refrigeration system work? Explain with suitable diagrams.

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