R18

Code No: 153BZ

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.Tech II Year I Semester Examinations, March - 2021

THERMODYNAMICS

(Mechanical Engineering)

Time: 3 hours Max. Marks: 75

Answer any five questions

All questions carry equal marks

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1.a) What is principle of thermometry? How could it help in designing the measurement of temperature? Explain.

b) A fluid at a pressure of 3.5 bar, and with specific volume of 0.2 m^3/kg, contained in a cylinder behind a Piston expands reversibly to a pressure of 0.8 bar according to a law $P = C/V^2$. Calculate the work done and heat transfer by the fluid on the piston. [7+8]

2.a) Explain the Joule's experiment to prove the first law of thermodynamics applied to a cycle.

b) Two thermometers, one centigrade and other Fahrenheit, are immersed in a fluid. After the thermometers reach equilibrium with the fluid, it is noted that both the thermometers indicate the same numerical value. Find the identical numerical value shown by the thermometers. [7+8]

3.a) What are the major limitations of first law of thermodynamics? How to overcome these limitations? Explain.

b) An air compressor handles 6.0 m^3/min of air with a density of 1.26 kg/m^3 and a pressure of 1.013 bar, and it discharges 450 kPa with a density of 4.86 kg/m^3. The change in specific internal energy across the compressor is 82 kJ/kg and heat loss by cooling is 24 kJ/kg. Neglecting KE and PE, find the work in kW. [7+8]

4.a) An engine working on Carnot cycle absorbs Q1 units of heat from a source at T_1 and rejects Q_2 units of heat to a sink at T_2. The temperature of the working fluid is Θ_1 and Θ_2, where $\Theta_1 < T_1$ and $\Theta_2 > T_2$, If $\Theta_1 = T_1 - kQ_1$ and $\Theta_2 = T_2 + kQ_2$, where k is constant, then show that efficiency of the engine is given by: $1 - (T_2/T_1 - 2kQ_1)$.

b) Draw the P-V-T surface for water and discuss the triple point and critical point data on the diagram. [8+7]

5.a) Derive the equation of state for perfect gas and discuss the importance of gas constant and Universal gas constant.

b) A thermally insulated vessel contains 3 kg mole of H_2 and 1.5 kg mole of N_2 each at 1 bar 27^0C initially they are separated by a partition wall. Determine the change in entropy when the partition wall is removed and the two gases mixes. [7+8]

6.a) What is the role compressibility charts in understanding the behavior real gases? Explain in detail.

b) A gas mixture consists of 0.4 kg of carbon monoxide, 1.1 kg of carbon dioxide and 1.5 kg of nitrogen. Determine: i) Mass fraction of each component ii) Mole fraction of each component iii) Average molar mass of the mixture and iv) the gas constant of the mixture. [7+8]

7.a) State the significance of Vander Waal's equation of state for real gases along with the compressibility factor charts.

b) 200 m^3 of air per minute at 15^0C DBT and 75% RH. If heated until its temperature is 25^0 C and find: i) relative humidity, ii) Wet Bulb Temperature and heat added to air per minute. [7+8]

8.a) Derive the equation for the thermal efficiency of Brayton cycle by drawing P-V and T-s diagrams.

b) A gas engine working on Otto cycle has a cylinder of diameter 220 mm and stroke 300 mm. The clearance volume is 1800 CC. Find the air-standard efficiency and mean effective pressure. Assume C_p =1.004 kJ/kg K and C_v = 0.718 kJ/kg K for air. [7+8]

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