Code No: 153BZ

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech II Year I Semester Examinations, August/September - 2022
THERMODYNAMICS
(Mechanical Engineering)

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

Answer any five questions
All questions carry equal marks
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1.a) Differentiate between exact and inexact differential and explain with suitable example.
b) A mass of 1.5 kg of air is compressed in a quasi-static process from 0.1 MPa to a final pressure 0.7 MPa by following the law $pv^{1.75}$ = constant. The initial density of air is 1.16 kg/m^3. Find the final density, work done by the piston during compression and heat transfer. [7+8]

2.a) What are the reference points to be considered for the absolute scale for the temperature measurement? Explain.
b) The properties of a certain fluid are related as follows. u = 196 + 0.178t & pv = 0.287(t+273) Where u is specific internal energy (kJ/kg), t is in ^{0}C, p is pressure (kN/m^2) and v specific volume (m^3/kg). For this fluid calculate C_v, C_p and R value. [7+8]

3.a) Explain the corollaries of first law of thermodynamics and discuss their important applications.
b) The air speed of a jet engine in flight is 550 m/s when the ambient air temperature is 10^0 C. The temperature at the outlet of nozzle is 600 ^{0} C and the corresponding enthalpy values for air and gas are respectively 50 kJ/kg and 1050 kJ/kg respectively. The fuel air ratio is 0.0190 and the calorific value of the fuel is 44.5 MJ/kg. Assume the heat loss from the engine is 25 kJ/kg of air. Calculate the velocity of the exhaust jet. [7+8]

4.a) A heat engine is used to drive a heat pump. The heat transfers from the heat engine and from the heat pump are used to heat the water circulating through the radiators of a building. The efficiency of heat engine is 27% and COP of the heat pump is 4. Evaluate the ratio of the heat transfer to the circulating water to the heat transfer to the heat engine.
b) State and explain the significance of third law of thermodynamics and discuss its practical applications. [5+10]

5.a) Draw P-V-T surface for pure substance water and discuss the salient features to understand Critical point and triple point.
b) Moist air enters an adiabatic saturator at 30^{0}C and leaves 20^{0}C, which is the adiabatic saturation temperature. The pressure remains constant at 100 kPa. Determine the relative humidity and the humidity ratio of the inlet mixture. [8+7]

6.a) Explain the importance of throttling process and derive the equation for Joules Kelvin coefficient.

b) One kg of steam initially at 1.1 MPa expands in a cylinder follows the law $pv^{1.13} = C$. The pressure at the end of the expansion is 0.1 MPa. Determine the final volume, final dryness fraction, the work done, the change in internal energy and heat transfer. [7+8]

7.a) How to make use of Vander Waal's equation for the estimation of properties of real gases? Explain.

b) Derive the equation for the estimation of COP for Bell Coleman cycle and explain the working principle. [8+7]

8.a) Compare and contrast Otto, Diesel and dual cycle for the same compression ratio and explain the salient points.

b) The volume ratios of compression and expansion for a diesel engine are 15.3 and 7.5 respectively. The pressure and temperature at the beginning of the compression are 1 bar and 27 ^{0}C. Assuming an ideal engine, determine the mean effective pressure, ratio of maximum pressure to mean effective pressure and cycle efficiency. [7+8]

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