Code No: 123AB **R15**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech II Year I Semester Examinations, October - 2020
THERMODYNAMICS
(Common to ME, AE)

Time: 2 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks
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1.a) What is the principle of thermometry? Explain the working principle of constant volume gas thermometer with a suitable diagram.
b) In a gas turbine power plant, the gas flow into turbine at 25 kg/s and develops the power 14 MW. The enthalpies of gases at inlet and outlet are 1180 kJ/kg and 350 kJ/kg respectively and the velocity of gases at inlet is 10 m/s and at exit 120 m/s. Calculate the rate at which heat is rejected to the turbine and the area of the inlet pipe given that the specific volume of the gases at the inlet is 0.45 m^3/kg. [7+8]

2.a) State and explain the corollaries of first law of thermodynamics with suitable examples.
b) A system with initial internal energy of 320 kJ is receiving heat of 290 kJ at constant volume process and rejects heat of 280 kJ at constant pressure when 56 kJ of work is done on the system. The system is brought to its original state by an adiabatic process. Calculate the adiabatic work and value of internal energy at salient points. [7+8]

3.a) Show that Kelvin Planck statement and Claussius statement of second law thermodynamics are equivalent.
b) A heat engine is used to drive a heat pump in which 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 the 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. [7+8]

4.a) Derive Maxwells relations from the first principles and explain the significance.
b) A cylinder-piston contains water at 200 kPa, 200 ^{0}C with a volume of 20 litres. The Piston is moved slowly, compressing the water to a Pressure of 800 kPa. The loading on the Piston is such that PV = C. Assume the room temperature as 20 ^{0}C and show that this process does not violate the second law of thermodynamics. [7+8]

5.a) Derive the equation for the heat transfer and work transfer for the polytropic process.
b) Steam at 15.5 bar and 0.89 dryness is throttled to a pressure of 3.5 bar. Using steam tables, evaluate the final state after throttled. Estimate the change of entropy during this process. [7+8]

6.a) Draw the PVT surfaces for the water and steam and explain the salient features.
b) 3.8 kg of air at pressure 7 bar occupies a volume of 0.27 m^3. This air is then expanded to a final volume of 1.32 m^3. Find the work done and heat absorbed or rejected by the air for each of the following processes (i) Isothermally, (ii) Adiabatically and (iii) Polytripically with index as 1.32. [7+8]

7.a) Explain Dalton's law of partial pressures for the gaseous mixtures and derive the equation for the perfect gas mixture.
b) 100m^3 of air per min at 40 ^{0} DBT and 15% relative humidity is passed through adiabatic humidifier. The air is coming out at 25^{0}C DBT and 20^{0}C WBT. Find (i) Dew point temperature, (ii) Relative humidity and (iii) Water carried by the air per min. [7+8]

8.a) Draw the schematic and thermodynamic diagrams of Bell Coleman cycle and derive the equation for COP.

b) An air-standard Otto cycle has a compression ratio of 9. The temperature and pressure at the beginning of compression process is 28 ^{0}C 1 bar respectively. If the maximum temperature of the entire cycle is given as 1250 ^{0}C, calculate (i) the heat supplied per kg of air, (ii) net work done per kg of air, and (iii) thermal efficiency of cycle. Assume $\gamma = 1.4$, $C_v = 0.718$ kJ/kg K for air. [7+8]

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