Code No: 138FQ **R16**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech IV Year II Semester Examinations, September - 2020
BASICS OF THERMODYNAMICS
(Civil Engineering)

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

Answer any Five Questions
All Questions Carry Equal Marks
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1.a) Show that internal energy is a property of the system.
b) Calculate the amount of heat required to convert 100 kg of ice at -10^0C into steam at 100^0C at normal pressure. Specific heat capacity of ice=2100 J/Kg K, latent heat of fusion of ice =3.36 × 105 J/Kg, specific heat capacity of water =4.2 kg K/kg-K and latent heat of vaporization of water = 2.25×10^6 J/kg. [8+7]

2.a) Explain about thermodynamic system and control volume.
b) A gas in a piston cylinder assembly undergoes an expansion process for which the relationship between pressure and volume is given by PV^n= const. The initial pressure is 0.3 MPa, the initial volume is 0.1 m^3 and the final volume is 0.2 m^3. Determine the work for the process in kJ if i) n = 1.5, ii) n=1.0 and iii) n=0. [8+7]

3.a) What do you understand by flow work? Is it different from displacement work?
b) Define a new thermodynamic scale say degrees N, in which the freezing point and boiling point of water are 100^0N and 300^0N respectively. Correlate this temperature scale with centigrade scale. [7+8]

4.a) What is a constant volume gas thermometer? Why is it preferred to a constant pressure gas thermometer?
b) A piston-cylinder device operates 1 kg of fluid at 20 atm. Pressure. The initial volume is 0.04 m^3. The fluid is allowed to expand reversibly following a process $pV^{1.4}$ = constant so that the volume becomes double. The fluid is then cooled at a constant pressure until the piston comes back to the original position. Keeping the piston unaltered, heat is added reversibly to restore it to the initial pressure. Calculate the work done in the cycle. [7+8]

5.a) Derive SFEE and hence deduce it to turbine.
b) The air speed of a turbojet engine in flight is 270 m/s. Ambient air temperature is -15^0C. Gas temperature of outlet of nozzle is 600^0C. Corresponding enthalpy values for air and gas are, respectively 260 and 912 kJ/kg. Fuel – air ratio is 0.0190. Chemical energy of the fuel is 44.5 MJ/kg. Owing to incomplete combustion 5 percent of the chemical energy is not released in the reaction. Heat loss from the engine is 21 kJ/kg of air. Calculate the velocity of the exhaust jet. [7+8]

6.a) Discuss about Clausius Inequality and its significance.
b) One kg of ice at -5^0C is exposed to the atmosphere which is at 20^0C. Ice melts and comes into thermal equilibrium with the atmosphere. Determine the entropy increase of the universe. [7+8]

7.a) Explain the Avagadro's law of additive volumes and its significance.
b) Compare and contrast the gravimetric and volumetric analysis. [8+7]

8.a) Derive the equation for COP of vapour compression refrigeration system.
b) A refrigerator uses R-134a as the working fluid and operates on an ideal vapour compression cycle between 0.14 and 0.8 Mpa. If the massflow rate of the refrigerant is 0.06 kg/s, determine (i) the rate of heat removal from the refrigerated space. (ii) The power input to the compressor, (iii) the heat rejection rate in the condenser and (iv) the COP. [15]

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