ME 211 – Thermo I
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Supplemental Problems 4

1. Mass enters an open system with one inlet and one exit at a constant rate of 50 kg/min. At the exit, the mass flow rate is 60 kg/min. If the system initially contains 1000 kg of working fluid, determine:
    a) dm/dt, treating the tank as a system
    b) the time when the system mass becomes 500 kg.

2. Steam enters an insulated tank through a valve. At a given instant, the mass of steam in the tank is found to be 10 kg, and the conditions at the inlet are measured as follows: A = 50 cm^2, V = 31 m/s, and ρ = 0.6454 kg/m^3. Determine:
    a) dm/dt, treating the tank as a system
    b) assuming the inlet conditions and tank contents remain unchanged, determine the mass of steam in the tank after 10 s.

3. Steam enters a mixing chamber at 100 kPa, 20 m/s and a specific volume of 0.4 m^3/kg. Liquid water at 100 kPa and 25^{o}C enters the chamber through a separate duct with a flow rate of 50 kg/s and a velocity of 5 m/s. If liquid water leaves the chamber at 100 kPa, 43^{o}C, 5.58 m/s and a volumetric flow rate of 3.357 m^3/min. Assume liquid water density to be 1000 kg/m^3 and steady state operation, then determine the port areas (in cm^2) at:
    a) the inlets
    b) the exit.