ME 24-221
Thermodynamics I

Solution Quiz No: 4
Date: 27 October 2000
Instructor; J. Murthy

Note: m^i is used to denote m_i-dot

Given:- Air; Ideal gas; Table A.7
Inlet 1: $m^1 = 0.1$ kg/s; $P_1 = 100$ kPa; $T_1 = 600$K
Inlet 1: $m^2 = 0.6$ kg/s; $P_2 = 100$ kPa; $T_2 = 700$K
Exit 1: $P_3 = 100$ kPa; $T_3 = 900$K

Solution: From continuity (or mass conservation equation),

$$m^1 + m^2 = m^3$$

Therefore, $\mathbf{m^3} = 0.1 + 0.6 = \mathbf{0.7\ kg/s}$ ----------(1)

Volumetric flow rate, $V^3 = (m^3/\rho_3) = m^3 v^3$ and $v^3 = RT_3/P_3$

Hence $\mathbf{V^3} = m^3 RT_3/P_3 = (0.7)(0.287)(900)/(100) = \mathbf{1.808\ m^3/s}$ ----------(2)

First law for Control volume (SSSF) for the given system:

$(m^3 h_3) - (m^1 h_1 + m^2 h_2) = Q^{cv}$

$h_3 = h_{900K} = 933.152$ kJ/kg

$h_1 = h_{600K} = 607.316$ kJ/kg

$h_2 = h_{700K} = 713.561$ kJ/kg

Hence, $\mathbf{Q^{cv}} = (0.7*933.152) - (0.1*607.316 + 0.6*713.561) = \mathbf{164.33\ kW}$ ----------(3)