Solution Quiz No: 4
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Instructor; J. Murthy

Note: \( m^1 \) is used to denote \( m_1 \)-dot

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

Solution: From continuity (or mass conservation equation),

\[
m^1 + m^2 = m^3
\]

Therefore,

\[
m^3 = 0.1 + 0.6 = 0.7 \text{ kg/s}
\]

Volumetric flow rate,

\[
V^3 = \frac{m^3}{\rho_3} = \frac{m^3 v^3}{R T_3}
\]

Hence,

\[
V^3 = \frac{m^3 R T_3}{P_3} = (0.7)(0.287)(900)/(100) = 1.808 \text{ m}^3/\text{s}
\]

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

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

\[
h_3 = h_{900K} = 933.152 \text{ kJ/kg}
\]

\[
h_1 = h_{600K} = 607.316 \text{ kJ/kg}
\]

\[
h_2 = h_{700K} = 713.561 \text{ kJ/kg}
\]

Hence,

\[
Q^{cv} = (0.7*933.152) - (0.1*607.316 + 0.6*713.561) = 164.33 \text{ kW}
\]