MEMS 0051 - Introduction to Thermodynamics
Quiz #4

Name: Solution

Problem 1

Determine the change of specific internal energy of air undergoing a process from 300 to 1,200 K using Table A.7.1.

$$du = u_2(1,200\,[\text{K}]) - u_1(300\,[\text{K}]) = (933.37 - 214.36)\,[\text{kJ/kg}] = 719.01\,[\text{kJ/kg}]$$

Problem 2

Determine the change of specific internal energy of air undergoing a process from 300 to 1,200 K using Table A.5.

$$du = C_{\forall 0}\,dT = (0.717\,[\text{kJ/kg-K}])(1,200 - 300)\,[\text{K}] = 645.3\,[\text{kJ/kg}]$$

Problem 3

Determine the change of specific enthalpy of air undergoing a process from 300 to 1,200 K using Table A.7.1.

$$dh = h_2(1,200\,[\text{K}]) - h_1(300\,[\text{K}]) = (1,277.81 - 300.47)\,[\text{kJ/kg}] = 977.34\,[\text{kJ/kg}]$$

Problem 4

Determine the change of specific enthalpy of air undergoing a process from 300 to 1,200 K using Table A.5.

$$du = C_{P0}\,dT = (1.004\,[\text{kJ/kg-K}])(1,200 - 300)\,[\text{K}] = 903.6\,[\text{kJ/kg}]$$

Problem 5

Determine the change of specific enthalpy of air undergoing a process from 300 to 1,200 K using Table A.6.
There are multiple ways to approach. The most accurate would is using the integral average of the constant pressure specific heat between the two temperature bounds:

$$dh = h_2 - h_1 = \int_{T_1}^{T_2} C_{P0}\,dT = \int_{\theta_1}^{\theta_2} C_{P0}(\theta)\cdot 1,000\,d\theta$$

$$dh = 1,000\left(1.05\,\theta - \frac{0.365\,\theta^2}{2} + \frac{0.85\,\theta^3}{3} - \frac{0.39\,\theta^4}{4}\right)\Bigg|_{\theta=0.3}^{\theta=1.2} = 979.19\,[\text{kJ/kg}]$$

The next most accurate method is evaluating C_{P0} at the average temperature:

$$dh = C_{P0}\,dT = C_{P0}(750\,[\text{K}])\,dT = (1.09\,[\text{kJ/kg-K}])(900\,[\text{K}]) = 981\,[\text{kJ/kg}]$$