Problem 1
An isentropic steam turbine processes $\dot{m} = 2 \text{ kg/s}$ of steam at $P_1 = 3 \text{ MPa}$, which is exhausted at $P_2 = 50 \text{ kPa}$ and $T_2 = 100^\circ\text{C}$. 5 percent of this flow is diverted for feedwater heating at $P_3 = 500 \text{ kPa}$.

Determine the power $W_{\text{out}}$ produced by this turbine.

Problem 2
A rigid tank (volume: $V = 0.5 \text{ m}^3$) contains refrigerant-134a initially at $P_1 = 200 \text{ kPa}$ and $x_1 = 0.4$. Heat is transferred now to the refrigerant from a source at $T_{\text{source}} = 35^\circ\text{C}$ until the pressure rises to $P_2 = 400 \text{ kPa}$.

1- Determine the entropy change of the refrigerant the rate of heat supplied to the heat engine ($\Delta S_{\text{R134a}}$)

2- Determine the entropy change of the heat source ($\Delta S_{\text{source}}$)

3- Determine the total entropy change for this process ($\Delta S_{\text{total}}$)

[solution: $\Delta S_{\text{total}} = 0.441 \text{ kJ/K}$]

Problem 3
An insulated piston–cylinder device initially contains $V = 300 \text{ L}$ of air at $P_1 = 120 \text{ kPa}$ and $T_1 = 17^\circ\text{C}$. Air is now heated for 15 min by a resistance heater (power: $W_{\text{elec}} = 200 \text{ W}$) placed inside the cylinder. The pressure of air is maintained constant during this process.

1- Determine the entropy change of air, assuming constant specific heats

2- Determine the entropy change of air, assuming variable specific heats

[solution: $\Delta S = 0.387 \text{ kJ/K}$]
**Problem 4**

A mass $m_c = 10 \text{ g}$ of computer chips with a specific heat $c = 0.3 \text{ kJ/kg} \cdot \text{K}$ are initially at $T_1 = 20^\circ \text{C}$. These chips are cooled by placement in a mass $m_{R134a} = 5 \text{ g}$ of saturated liquid R-134a at $T_2 = -40^\circ \text{C}$. The pressure remains constant while the chips are being cooled.

1. Determine the entropy change of the chips ($\Delta S_{\text{chips}}$), the R-134a ($\Delta S_{R134a}$), and the entire system ($\Delta S_{\text{total}}$).

2. Is this process possible? Why?