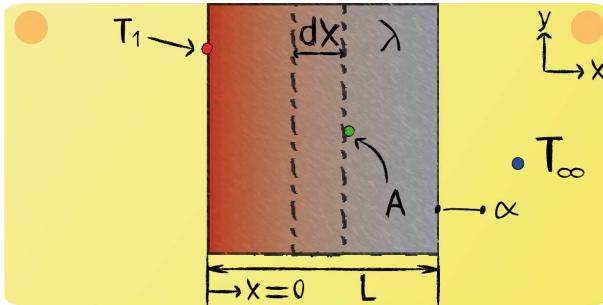


Lecture 6 - Question 6



Set up the energy balance for a one-dimensional steady-state heat transfer through the wall subjected to convection α on the right-hand side with the cross-sectional area A and give the corresponding boundary conditions. There is no heat sink or source in the wall.

Energy balance:

$$\dot{Q}_{x,in} - \dot{Q}_{x,out} = 0$$

The sum of the in- and outgoing heat fluxes of the control volume should equal zero, because of steady-state conditions.

Heat fluxes:

$$\dot{Q}_{x,in} = -\lambda A \frac{\partial T}{\partial x}$$

$$\dot{Q}_{x,out} = -\lambda A \frac{\partial T}{\partial x} + \frac{\partial \dot{Q}_{x,in}}{\partial x} dx$$



The heat flux entering the control volume can be described by use of Fourier's law. The outgoing heat flux can be approximated by use of the Taylor series expansion.

Boundary conditions:

$$T(x = 0) = T_1$$

$$\frac{\partial T(x=L)}{\partial x} = -\frac{\alpha}{\lambda} (T(x = L) - T_\infty)$$

The first boundary condition describes that the temperature on the left side equals T_1 . The second boundary condition results from the fact that $\dot{Q}_{x=L} = -\lambda A \frac{\partial T(x=L)}{\partial x} = \alpha A (T(x = L) - T_\infty)$.