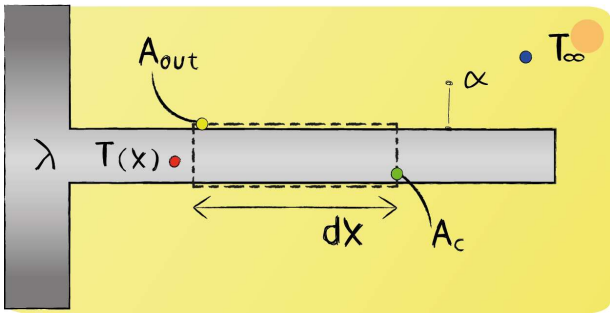
# Lecture 9 - Question 7




Give the energy balance to derive the fin equation. Assume one-dimensional steady-state heat transfer in x-direction. The surface area temperature of the fin T(x) changes in axial direction.

**Energy balance:**

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

Since the heat transfer is characterized as steady-state, the sum of the in- and outgoing heat fluxes for the control volume should equal zero.

**Heat fluxes:**

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

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

$$\dot{Q}_{conv}(x) = \alpha \cdot A_{out} \left(T(x) - T_\infty\right)$$

The heat entering the system is transferred from the base by conductive heat transfer. This heat flux is distributed over a convective and conductive heat flux. $\dot{Q}_{conv}(x)$ can be described by Newton's law of cooling, $\dot{Q}_{x,out}$ can be approximated by use of the Taylor series expansion.