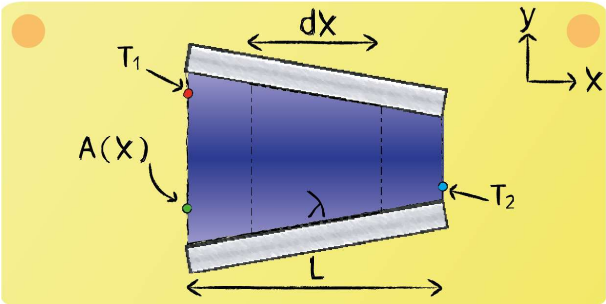
Lecture 2 - Question 6



Develop an energy balance to calculate the temperature profile inside the truncated cone and give the boundary conditions. The sides are covered with an isothermal wall. Assume for that reason one-dimensional steady-state conditions. $A(x)$ can be denoted as A.

Energy Balance:

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

Heat Fluxes:

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

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

The in and outgoing flux should equal each other and are characterized by conductive heat transfer. The outgoing flux can be approximated by use of the Taylor series expansion. This because the cross sectional area along x is not constant.

Boundary conditions:

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

$$T(x=L) = T_2$$

The boundary conditions above describe that the temperature of the body equals T_1 on the left side and T_2 on the right side, as can be seen in the sketched situation.