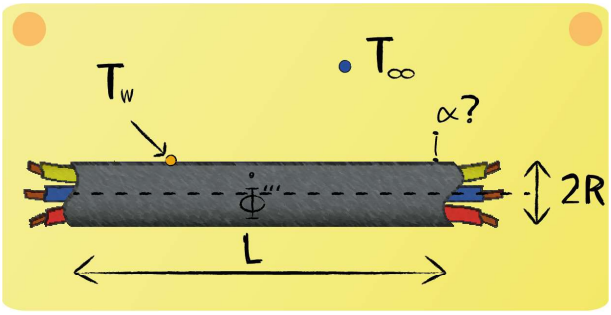
Lecture 8 - Question 7



Due to the voltage drop in a cable, heat is generated at a constant rate $\dot{\Phi}'''$. Provide the governing energy balance to determine the heat transfer coefficient α.

Energy balance:

$$\dot{\Phi} - \dot{Q}_{out} = 0$$

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

Heat fluxes:

$$\dot{\Phi} = \dot{\Phi}''' \cdot \pi \cdot R^2 \cdot L$$

$$\dot{Q}_{out} = \alpha \cdot 2\,\pi \cdot R \cdot L\,(T_w - T_\infty)$$