I. Heat transfer

Symbology

Symbol	Quantity	Unit
λ	Thermal conductivity	$W/(m \cdot K)$
$\dot{q}$	Heat flux	W/m^2
$\dot{Q}$	Heat flow	W
a	Thermal diffusivity	m^2/s
α	Heat transfer coefficient	$W/(m^2 \cdot K)$
k	Thermal conductivity	$W/(m \cdot K)$

1. Types of heat transfer

1.1 Heat conduction

Occurs with all materials when there is a temperature gradient.

Steady-state conduction (1st Fourier's law):

$$\dot{q} = -\lambda \frac{\mathrm{d}T}{\mathrm{d}x}$$

Transient conduction (2nd Fourier's law 1D):

$$\frac{\partial T}{\partial t} = \frac{\lambda}{\rho c_p} \frac{\partial^2 T}{\partial x^2}$$

1.2 Convective heat transfer

This occurs in moved fluids.

Newton's approach:

$$\dot{q} = \alpha \left(T_1 - T_2 \right)$$

1.3 Radiation

Bodies with a temperature above 0 K emit thermal radiation.

2. Heat conduction and conductivity

2.1 Heat flux and Heat flow

$$\dot{q} = -\lambda \frac{\mathrm{d}T}{\mathrm{d}x} = k\Delta T = \frac{\lambda}{\delta} \Delta T \quad | \quad \dot{Q} = \frac{\Delta Q}{\Delta t} = \dot{q}A = kA\Delta T = \frac{\lambda}{\delta} A \Delta T$$

2.2 Thermal conduction k^{-1} and Thermal conductivity k

$$k_{\text{tot}}^{-1} = \sum_{i=1}^{n} \frac{\delta_i}{\lambda_i} \implies k_{\text{tot}} = \frac{1}{k_{\text{tot}}^{-1}}$$