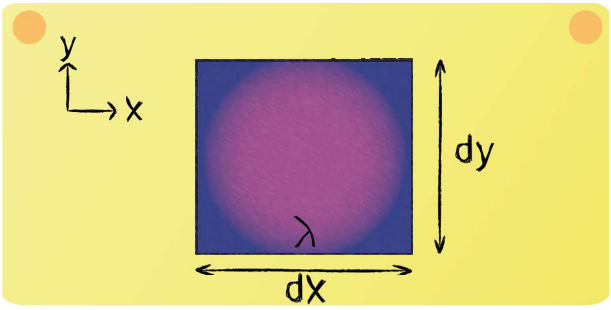
Lecture 2 - Question 5



Give the energy balance and describe the heat. Assume two-dimensional steady state heat transfer with a source. Take $dz = 1m$

Energy balance:

$$\dot{Q}_{x,in} + \dot{Q}_{y,in} - \dot{Q}_{x,out} - \dot{Q}_{y,out} + \dot{\Phi}''' \cdot V = 0$$

It is denoted that we are dealing with a source. For that reason the term $\dot{\Phi}''' \cdot V$ should be positive.

Heat fluxes:

$$\begin{aligned}
\dot{Q}_{x,in} &= \dot{q}''_{x,in} \cdot dy \\
\dot{Q}_{x,out} &= \dot{q}''_{x,out} \cdot dy \\
\dot{Q}_{y,in} &= \dot{q}''_{y,in} \cdot dx \\
\dot{Q}_{y,out} &= \dot{q}''_{y,out} \cdot dx \\
\dot{\Phi}''' \cdot V &= \dot{\Phi}''' \cdot dx \cdot dy
\end{aligned}$$

$\dot{q}''$ describes the heat flux density $[W/m^2]$, multiplying it with its corresponding surface area ($dx \cdot dz$ or $dy \cdot dz$) results in $\dot{Q}$ the heat flux $[W]$