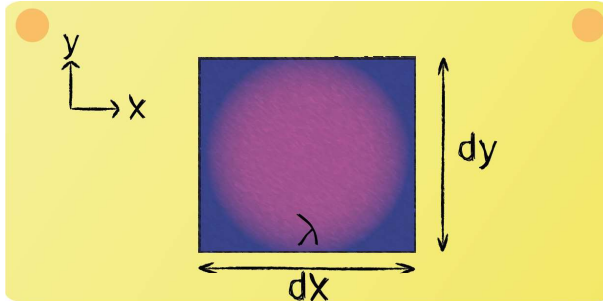# Lecture 2 - Question 5

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:

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

$$\dot{Q}_{y,in} = -\lambda A \frac{\partial T}{\partial y}$$

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

$$\dot{Q}_{y,out} = -\lambda A \frac{\partial T}{\partial y} + \frac{\partial \dot{Q}_{y,in}}{\partial y} dy$$

$$\dot{\Phi} = \dot{\Phi}''' \cdot dx \cdot dy$$

The heat fluxes are described by conductive heat transfer. The outgoing heat fluxes can be approximated by use of the Taylor series expansion.