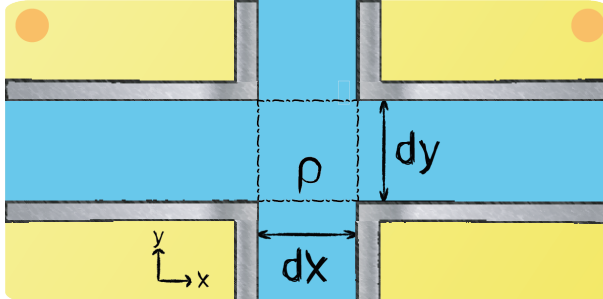# Lecture 1 - Question 7

Give the mass balance and a description for the mass fluxes and the change of mass over time of the control volume. Assume transient mass transfer. The fluid is compressible. Furthermore the control volume has the dimensions dx, dy and dz.

Mass balance:

$\frac{\partial m}{\partial t} = \dot{m}_x(x) - \dot{m}_x(x + dx) + \dot{m}_y(y) - \dot{m}_y(y + dy)$

Mass fluxes:

$$\frac{\partial m}{\partial t} = \frac{\partial \rho}{\partial t} dx dy dz$$

$$\dot{m}_x(x) = \rho u(x) dy dz$$

$$\dot{m}_x(x + dx) = (\rho u(x) + \frac{\partial \rho u(x)}{\partial x} dx) dy dz$$

$$\dot{m}_y(y) = \rho v(y) dx dz$$

$$\dot{m}_y(y + dy) = (\rho v(y) + \frac{\partial \rho v(y)}{\partial y} dy) dx dz$$

The change of mass over time, is equal to the change of density over time, multiplied with dV. The ingoing fluxes are described by density · velocity · cross sectional area. The outgoing fluxes are approximated by use of the Taylor series expansion.