KMÜ 427-21

TRANSPORT THEORY

HOMEWORK 3 (Due January 2, 2020)

1. Radial flow between two coaxial cylinders. Consider an incompressible fluid, at constant temperature, flowing radially between two porous cylindrical shells with inner and outer radii KR and R.

(a) Show that the equation of continuity leads to $v_r = C/r$ where C is a constant.

(b) Simplify the components of the equation of motion to obtain the following expressions for the modified-pressure distribution:

$$\frac{d\mathcal{P}}{dr} = -\rho v_r \frac{dv_r}{dr} \quad \frac{d\mathcal{P}}{d\theta} = 0 \quad \frac{d\mathcal{P}}{dz} = 0$$

(c) Integrate the expression for dP/dr above to get

$$\mathcal{P}(r) - \mathcal{P}(R) = \tfrac{1}{2}\rho[v_r(R)]^2\left[1 - \left(\frac{R}{r}\right)^2\right]$$