1. Show that the Oseen and Taylor vortices

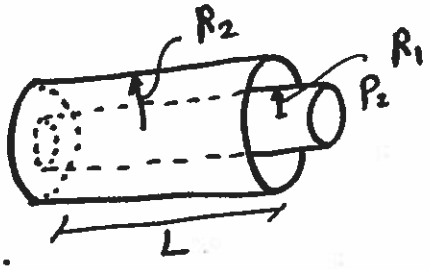
with $v_\theta = \frac{\Gamma}{2\pi r}\left(1 - e^{-r^2/4\nu t}\right)$, $v_r = v_z = 0$

and $v_\theta = \frac{\Pi}{8\pi}\frac{r^2}{\nu t^2}\exp\left\{-\frac{r^2}{4\nu t}\right\}$, $v_r = v_z = 0$

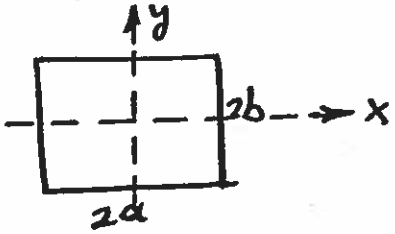
are exact solutions of the Navier-Stokes equation.

2. Obtain the velocity profiles $v_z(r)$ and $v_\theta(r)$ for helical flow in an annular region.

The inner and outer pipes rotates with angular velocities ω_1 and ω_2 respectively.



3. Find the velocity profile for a duct with rectangular cross-section. Assume steady flow with a constant $\frac{dp}{dz}$.



4. Determine the unsteady velocity profile which is developed if the lower plate is set suddenly in motion. The fluid is initially at rest.