4.1 *Hydrodynamic volume force in polar coordinates*

Derive the components of the hydrodynamic volume force, $\boldsymbol{\Sigma}$, in cylindrical polar coordinates.

4.2 *Hydrodynamic pressure*

Demonstrate that the negative of the pressure, $-p \equiv \frac{1}{3}\mathrm{trace}(\boldsymbol{\sigma})$, is the average of the normal component of the traction exerted on the surface of a spherical fluid parcel with infinitesimal dimensions.

4.3 *Energy dissipation in shear flow*

Compute the rate of energy dissipation inside a parcel of an Newtonian fluid in simple shear flow with velocity $u_x = \xi y$, $u_y = 0$, $u_z = 0$, where ξ is a constant shear rate.

4.4 *Function of a tensor*

Consider a function $f(x)$ defined through its Taylor series expansion. Show that if $\mathbf{T}$ is a tensor, then $\mathbf{f}(\mathbf{T})$ is also a tensor.