Advanced Fluid Dynamics **Prof. A.J. Hogg**
Syllabus **October 2016**

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0. Introduction, motivation and preliminary skills

1. The governing equation for viscous fluid flow

   Conservation of mass; stress and rate of strain tensors; Navier-Stokes equation; dissipation; boundary conditions; vorticity.

2. Simple fluid flows

   Solution to the Navier-Stokes equations for simple geometries; steady flows along pipes and between parallel plates; oscillating flows; impulsively started flows; flows with circular streamlines.

3. Dynamical similarity and the Reynolds Number

   Dimensionless governing equations and the definition of the Reynolds number; interpretation; simple examples.

4. Flows with negligible inertia (Reynolds number$\ll 1$)

   Stokes' equations; corner flows; settling particles; lubrication flows; spreading droplets.

5. Flows with inertia (Reynolds Numbers$\gg 1$)

   Singular perturbations of the Navier-Stokes equations; boundary layer flows; similarity solutions; production of vorticity; separation; wakes.

6. Instabilities

   Linear instability theory of shear flows, vortex sheets and flows with density gradients.