Course content for MT3290/4290, Dynamics of Real Fluids

Prerequisites:
MT2220

Aims:
This course aims to give an overview of how the theory of ideal fluids met in MT2220 can be extended to a more realistic model. It will show how the equations can be solved in simple cases and how other methods such as conservation laws and dimensional analysis can be used in more complicated cases.

Learning outcomes:
On completion of the course the student should be able to:

- demonstrate an understanding of the essential features of compressible flow, sound waves and shock waves;
- tackle a variety of problems involving surface waves on a liquid;
- solve simple problems in viscous flows;
- apply appropriately and with confidence basic vector analysis techniques and the additional general mathematical techniques introduced in this course.

Course content:
Compressible flow: Relation between pressure and density. Linear small amplitude waves in a gas and possible solutions of the wave equation. Plane and spherical waves. Waves in pipes: harmonics and normal modes. Shock waves.
Surface waves on a liquid: Small amplitude waves on a fluid of arbitrary depth. Stationary waves on a moving stream. Waves on an interface. What happens if wave speed depends upon wavelength: dispersion and group velocity.
Viscous fluids: Discussion of the effects of viscosity by means of a stress tensor leading to the extra terms that need to be included in the equation of motion. Problems for which exact solutions can be found. The Reynolds number as a measure of the importance of viscosity.