

SCMS. MATH 553A: *Fluid Dynamics*: Course Outline
Lecturer:

Dr. Sean Oughton. Office G3.07, ext 8326.
 Email: seano@waikato.ac.nz

Lectures: In room G3.33: Mon 10, Wed 12, Fri 10

Aim of Course: To provide an introduction to the theory of fluid dynamics and associated problem-solving techniques.

Syllabus*:

1. *Cartesian tensors. Definition of the stress tensor. Review of Vector Analysis.*
2. *Derivation of the equations of continuum mechanics.*
3. *Rate of strain tensor. Derivation of the Navier–Stokes Equation.*
4. *Exact Solutions of the Navier–Stokes Equations.*
 Some simple solutions where the flow is irrotational or $(\mathbf{v} \cdot \nabla)\mathbf{v} = 0$. Flow towards a stagnation point. Flow in a converging or diverging channel.
5. *Vorticity.*
 Topics from: Equations of vorticity, Helmholtz’s theorem. Formation of vorticity. Kelvin–Helmholtz instability. Line vortices. Self-induced motion of a line vortex. Hill’s spherical vortex.
6. *Shallow Water Equations.*
7. *Miscellaneous.*
 Depending on time, possible topics include boundary layers, waves, linear stability, turbulence, ...

Textbooks:

There is no required textbook, however, the following books are useful references:

- Patterson, A.R. *A First Course in Fluid Mechanics* Cambridge Univ. Press, 1983.
- Batchelor, G.K. *An Introduction to Fluid Dynamics*, Cambridge Univ. Press, 1967.
- Landau, L.D. and Lifshitz, E.M. *Fluid Mechanics* Pergamon, 1987.

Assessment:

The paper is internally assessed using assignments (25% of final grade) and a final two hour test (75% of final grade). The test will be held in the end of semester exam period (June 13–25 in 2011).

Assignments will be set every 1–2 weeks. Each assignment is compulsory.

All work should be handed in by 1pm on the due date.

Late Assignments:

Late assignments will normally be awarded *ZERO* marks.

However, if you fail to complete an assignment on time *with good reason* (illness, etc.), you may apply to the lecturer for special consideration. The application should be made in writing no later than three days after the date on which the work was due. You should provide a medical certificate from a *registered medical practitioner*, in the case of illness, or appropriate other written evidence. The procedure for assessment in such circumstances may involve awarding of an estimated mark or the opportunity to submit an alternative assessment item. Detailed regulations can be found in the University Calendar.

Other Information:

Information regarding the University’s regulations and policies (in particular those regarding assessment and discipline) is available in the University Calendar.

*The choice of topics may vary slightly from this listing.