MATH 3375 (5376) 2011-12 Hydrodynamic Stability Prof. D.W. Hughes

Lectures and Examples Classes

Lectures and classes will be held at the following times and places:

For level 3 *and* level 5 students:

Tuesday 12 noon Roger Stevens LT 05
Thursday 11 am Roger Stevens LT 05
Friday 10 am Roger Stevens LT 12

For level 5 students only:

Friday 12 noon Roger Stevens LT 06

Of the 33 timetabled hours common to both levels 3 and 5, I will use approximately 27 for lectures and 6 for classes. Exactly which slots will be used for classes will be determined as the course evolves. I cannot stress too strongly how important it is that you take time to tackle the questions on the examples sheets in advance of the examples classes; by doing this you will get much more out of the classes.

For students taking the course as MATH5376, the Friday slot at 12 noon will be used sometimes as a lecture and sometimes as an examples class; an additional topic will be studied at this time.

You should attend all lectures and classes.

Although the final mark is 100% based on the final examination, I would like to mark selected questions on the examples sheets. This gives me a better idea of any difficulties that students may be having, and will allow me to help them accordingly.

If you have any problems with the course, even after the examples classes, please come and find me in my office (8.18p School of Mathematics) and I will be very happy to help. Or else email me (d.w.hughes@leeds.ac.uk) to arrange a convenient time.

All of the handouts will be on the Web site. I will hand out solutions to the examples sheets, which will, at a later date, also be put on the Web site.

http://www.maths.leeds.ac.uk/∼dwh/MATH3375/

You can also access this page via the link on the VLE.

Booklist

D.J. Acheson, *Elementary Fluid Dynamics*, Clarendon Press, Oxford, 1990. This is an excellent overall introduction to fluid dynamics.

A.R. Paterson, *A first Course in Fluid Dynamics*, Cambridge University Press, 1983. This is another good introduction to the subject.

The following books concentrate specifically on hydrodynamic stability:

P.G. Drazin, *Introduction to Hydrodynamic Stability*, Cambridge University Press, 2002.

P.G. Drazin and W.H. Reid, *Hydrodynamic Stability*, Cambridge University Press, 1981.

S. Chandrasekhar, *Hydrodynamic and Hydromagnetic Stability*, Clarendon Press, Oxford, 1961.

Outline Syllabus

1. Brief review of the basic ideas of fluid dynamics.

2. The governing equations of viscous fluid dynamics.

3. Introduction to the basic ideas of hydrodynamic stability (linear and nonlinear).

4. Linear theory of Rayleigh-Bénard convection. Derivation of governing equations in the Boussinesq approximation. Non-dimensionalisation and boundary conditions. Analysis of dispersion relation. Global bounds for stability.

5. Rotating flows. Linear theory of Taylor-Couette flow; Rayleigh's criterion.

6. The linear stability of parallel shear flows; Squire's theorem, Rayleigh's inflexion point criterion, Fjørtoft's criterion. Kelvin-Helmholtz instability.

7. Students taking the course as MATH 5376 will study further aspects of convection, such as double-diffusive convection and convection in the presence of rotation.