School of Geography, Environment and Earth Sciences
and School of Mathematics, Statistics and Computer Science

MATH 321/322/323
Module on Fluid Flow in Earth Systems
2014 Module Outline

MATH 321 322, 323 2014

Module on Fluid Flow in Earth Systems

Lecturer: **Professor Martha Savage**

email: Martha.Savage@vuw.ac.nz, Tel: 463-5961, room Cotton 522 (Temporarily in MY1114)

Module Objectives:

- To provide an introduction to fluid mechanics and its application to Earth problems. The emphasis will be on fluid flow of very viscous fluids.
- To introduce the concept of numerical analysis of solutions to differential equations, with an application to flow and strain in the mantle. In particular, the Finite Difference technique will be used and examined. However, the full development of the techniques is beyond the scope of this section.
- Builds on previous lecture block involving tensors, stress and strain (Euan's Cartesian Tensors module)

Prerequisite: Maths 322/323 Cartesian Tensors Module.
Contact: This is a lecture course with two parts: analytic and numerical. The first three weeks will include the basic concept of fluid flow and problem sets will be based on analytic solutions. The last three weeks will involve understanding, using and developing several computer programs and spreadsheets: Most use the Finite Difference Method.

6 weeks with 3 1-hr tutorials per week will be set up to help with the problem sets and the computer, during the normally scheduled classes.

Timing: Last 6 weeks Trimester 2, 8 September-17 October.
Location: Von Zedlitz VZ103, Monday, Tuesday,Wednesday and Friday 12:00-12:50

Assessment: Internal - two parts:
- Three assignment sets on analytic solutions counting 50% of the total.
- Three computer assignments counting 50% of the total.

Assignment due dates
There will be six weekly assignments. Each will be due one week after handout.
There will be penalties of 5% of marks per day for late work.

Topics Intended to Cover (Note: This is a tentative outline only. It may be changed somewhat based on interests of students and lecturer.)

Navier -Stokes equation for fluids
One-dimensional Channel flows
Two-dimensional flow

The stream function
Applications: postglacial rebound, subduction angles, boundary layer theory for thermal convection, convection in the Earth's mantle
Numerical integration
Finite difference method
Heat flow

Reading:

A set of Course notes will be available on sale during trimester 2, which will contain excerpts from the important parts of the books below plus some extra reading material. Those of you intending to go on to graduate study in Geophysics might like to purchase a copy of Turcotte & Schubert via amazon.com

Turcotte & Schubert, Geodynamics applications of continuum physics to geological problems / Donald L. Turcotte, Gerald Schubert.
Publisher: New York : Wiley, c1982 or 2000.
ISBN: 0471060186
QE501 T933 G

Any book on Fluid Mechanics, such as:
Long, R.R. Mechanics of Solids and Fluids (Prentice Hall) QA 931 L849 M
Fung, Y.C. A First Course in Continuum Mechanics (Prentice Hall) QA 808.2 F981 F