**MATH/GPHS 321, 322, 323 2013**

**Cartesian tensors and introduction to continuum mechanics**

**Module Outline**

**Lecturer:** Prof. Euan Smith

 CO517, ph. 4636422, email euan.smith@vuw.ac.nz

**Course Objectives:**

- To introduce the concept of Cartesian tensors

- To introduce some applications, especially in continuum mechanics – stress and strain, Euler’s equation of motion,

Navier’s equation of motion, Navier-Stokes equation

**Contact:** Approx. 11 lectures plus 5 tutorials, which will be informal problem-solving sessions.

**Lectures:** Mon, Tues 1200-1250, Mar 5 to April 16, KK202

**Tutorials** Fri 1200-1250, Mar 8 to April 19, KK202

**Assessment:** Internal

- Four assignments counting 80% of the total, and an essay 20%.

**Topics Intended to Cover**

Fundamental principle of representation of physical quantities

Change of coordinate system

Introduction to Cartesian tensors

Tensor algebra and calculus

Applications:

Concept of Stress - the stress tensor – symmetry of the stress tensor

Real symmetric matrices - Principal Axes and Components

Concept of Strain - strain tensor – rotation tensor

- the strain ellipsoid

- pure and simple shear

 Hooke’s Law for isotropic materials

 Gauss’s Law

Euler‘s equation of motion

Navier’s equation for elastic materials

Navier -Stokes equation for fluids

**Reading:**

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

Any book on the introduction to Cartesian Tensors (there are many in the Library QA807, 808, etc.)

*Fun:* Gordon, J.E. The new science of strong materials (or, why you don’t fall through the floor) (Princeton Science Lib). Architecture Library. 3-day loan, TA403.2 G663 N 1974

**Assignment due dates**

Assignments will generally be due at the end of the week following the one in which they were set. Tutorial exercises will be given out with assignments. At tutorials time is available to ask questions about assignments.

**Plagiarism**. Any *unacknowledged* collaboration with another student is plagiarism. Plagiarised assignments will receive no marks. If you obtain help from another student with an assignment it must be acknowledged in the answers. ***Copying another’s answers is completely unacceptable***. **MATH/GPHS 321,322, 323 2012 Differential Equations in Earth Science Module**

# MODULE STARTS Monday 29 April, after the mid-T1 break

**Module Outline**

**Lecturer:** Prof. Euan Smith

 CO517, ph. 463 6422, email euan.smith@vuw.ac.nz

**Course Objectives:**

* To introduce three important partial differential equations of geophysics: the Laplace’s equation, the wave equation, and the heat diffusion equation
* To give an example or two of how to solve each one in a practical situation

Students are strongly recommended to do the ‘Tensors’ module before this one.

**Contact:** Approx. 11 lectures plus 6 tutorials, which will be informal problem-solving sessions.

**Lectures:** Mon, Tues 1200-1250, April 29 to May 28, KK202

**Tutorials** Fri 1200-1250, May 3 to May 31, KK202

**Assessment:** Internal

- Four two-weekly assignments counting 100% of the total.

**Topics Intended to Cover**

Laplace’s equation – derivation and application to earth deformation

The wave equation – derivation and application to interface waves

The heat diffusion equation – derivation and application to the ocean cooling problem and

diurnal and annual heating of the earth

**Reading:**

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

Turcotte and Schubert Geodynamics – applications of continuum physics to geological problems

Stein, Seth and An Introduction to Seismology, Earthquakes and Earth Structure (Blackwell)

Michael Wysession

**Assignment due dates**

Assignments will be set every other week. Tutorial time is available to ask questions about assignments.

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