MATHS 363 Advanced Modelling and Computation
Study Guide, Second Semester 2011

- **Description:** Much of modern research in applied mathematics, physics and engineering relies heavily on the construction and numerical solution of mathematical models. The course covers the theory and practice of such computational approaches, including the computation of solutions to ODEs and PDEs, the study of first order PDEs and bifurcations in ordinary differential equations. Matlab is used extensively.

- **Text:** "Advanced Engineering Mathematics", 2nd edition, by Michael D. Greenberg. Not everything we do is covered by this book, so we also recommend the following.

- **Recommended reading:** (The relevant parts of these texts are available through cecil)

  1. Introduction to Numerical Methods in Differential Equations by Mark H. Holmes, Springer Texts in Applied Mathematics.
  2. Nonlinear Dynamics and Chaos, by Strogatz, Addison-Wesley, 1994
  3. Applied Partial Differential Equations,4th edition, by Richard Haberman.Pearson Education

- **Lecturers**
  Steve Taylor, Room G09, Ground Floor, 70 Symonds St. s.taylor@auckland.ac.nz. Extension: 86622. Phone: 9236622.
  Maryam Alavi, Room 361, Building 303S, m.alavi@math.auckland.ac.nz.

- **Office hours:** These will be announced after lectures start.

- **Lecture hours:** 11 am, Monday in Engineering 3402,
  12 noon, Thursday in Engineering 3407,
  11 am Friday in Old Choral Hall 2.
  You should have picked one Tutorial/Lab hour when you enrolled. This Lab will be in the Basement Teaching Lab.

- **Coursework and Test:** We will have a mid-semester test. This will probably be in MLT1, Friday 16th September at 11am. This will be confirmed later.

  Four assignments will be set and marked. Assignments are a crucial part of the course and must be completed by all students. Due dates are

  1. Thursday 11th August
  2. Thursday, 25th August
  3. Thursday, 29th September
  4. Thursday, 13th October

- **Computing:** Computational methods are a crucial part of this course. You cannot get by without being able to write simple computer programs. Matlab will be available to all students in the computer lab. We will provide a set of notes on how to use Matlab.

  Programming will be absolutely required for the assignments, and all students must be prepared to give a detailed oral explanation of their programs and results if asked to do so. It is crucial you write your own programs and do your own work. Discussions are encouraged, copying is not. If we see any indications of copying, both students involved will lose all marks for that assignment.

- **Assessment:** The final grade will be determined by the formula

  $$20\% \text{ assignments} + 20\% \text{ test} + 60\% \text{ exam}$$

  subject to an attainment of at least 35% on the combined exam and test mark. If less than 35% is achieved in the combined exam and test mark, the final grade will be determined by the exam and test alone. So if you fail these badly, you can't be saved by your coursework.

- **Syllabus**

  1. Conservation Laws and Traffic flow (3 weeks) (We follow the treatment in Chapter 12 of Haberman).
  2. Numerical solution of ODEs (1 week). Chapter 6 of Greenberg.
  3. Two point boundary value problems (boundary value problems in 1 dimension) (1 week). Chapter 6 of Greenberg and a few details in Chapter 2 of Holmes.
  4. Diffusion Problems (2 weeks) Section 18.6 of Greenberg
  5. Elliptic Problems (boundary value problems in 2 or more dimensions) (2 weeks) Section 20.5 of Greenberg
  6. Elementary bifurcations and nonlinear dynamics. (3 weeks) (We follow the treatment in Strogatz)