THE UNIVERSITY OF SYDNEY
MATH3963

Semester 1	Nonlinear ODEs with Applications (Advanced)	2016

Information Sheet

Lecturer: Robert Marangell (Room 720, Carslaw Building)
Consultation Hour: Wednesdays 16:00-17:00 in my office
Additional Consultation: By appointment.
Please arrange via e-mail (robert.marangell@sydney.edu.au)

Outline & Learning Outcomes: This course serves as an introduction to the more modern theory of differential equations and dynamical systems. The emphasis is on obtaining a *qualitative* understanding of properties of a system. This course intertwines the study of the theory of ODEs with applications to systems modelling various phenomena. The more theoretical part includes a study of existence and uniqueness theorems for linear and nonlinear equations, asymptotic behaviour for nonlinear ODEs and elementary bifurcation theory. The applications in this unit will be drawn from mechanical, biological and chemical models, and other equations and systems from applied mathematics.

Mathematical Learning Outcomes:
Understanding of topological methods: phase plane analysis, equilibrium states, stability analysis, bifurcation theory. *Understanding of analytical methods*: matrix analysis, solvability, existence and uniqueness of solutions.
Scientific Learning Outcomes:
Familiarity with relevant examples of: ecosystem population dynamics, elementary mechanical systems, growth and harvesting, predator-prey systems, chemical reactions and oscillations.

Assessment: Midterm = 25%; Assignments = 20%; Examination = 55%

Test: There will be a midterm test (45 minutes) in week 7 (3 weeks after Easter break). The test will be given on **Thursday, April 21st at 12:00pm**. There will be a final examination. The time and date of the final exam will be announced later in the semester. **Material covered on the midterm and the final exam (and on the assignments) will be based on the material in the lecture notes and the tutorial sheets**.

Assignments: There will be two assignments.

- Assignment 1: Will be handed out at the end of week 2, and **due 4/4 at the start of week 5 (after the break).**
- Assignment 2: Will be handed out at the end of week 10 and **due 30/5 at the start of week 13.**

Assignments must be **typed** and a pdf copy must be submitted via the turnitin system on the blackboard website for this course. Hand written assignments or photographs thereof will not be accepted.

Late work will be penalised by the loss of a full mark for any part of a 24 hour period after your assignment is late (i.e. if you turn in the assignment 1 minute late to 24 hours late your maximum mark could be an 85, 24 hours & 1 minute late to 48 hours your maximum mark could be a 75 etc).

Solutions will be posted 1 week (electronically) after the assignment is due.

(For typing mathematics, I recommend learning the markup language LaTex. This is already on the computers in the Carslaw labs. If you wish to get it yourself, for Windows/Linux machines you can find it here: http://miktex.org for a Mac: http://tug.org/mactex). I have provided a LaTeX template on the blackboard website.

Computer Lab: All tutorials will be held in the computer lab, though not all tutorials will be entirely on the computer. In some of the early tutorials, I will give an introduction to the software packages Mathematica and MATLAB. You will need to be able to use these software packages for some of the tutorials and parts of the assignments. If you are already familiar with other software packages (such as Maple, XPPAUT, etc) then you can use them as well.

Web Site: The MATH3963 web page can be found as a link on the Senior Mathematics page:

`http://www.maths.usyd.edu.au/u/UG/SM/MATH3963`

There will also be a link to the Blackboard (LMS) website on this website. The Blackboard site can by found by signing into:

`https://elearning.sydney.edu.au`

This site is where I will post the assignments, tutorials and lecture notes. It is also where you must turn in the pdf copy of your assignments via turnitin.

References: In addition to lectures, I will provide some lecture notes online. The main supplementary text for this course is the textbook:
Differential Dynamical Systems. J. D. Meiss. Series on Mathematical Modeling and Computation. SIAM - Philadelphia, PA 2007.
which is on reserve for MATH3963 in the SciTech Library. You may also like to browse through other books in Sections 517, 570–575 (there is a lot of material available for different parts of the course).

Assumed Knowledge:

Calculus (MATH1901, MATH1903): differentiation and integration techniques; solving separable and linear differential equations; fundamental theorem of calculus; mean value theorem;

Linear algebra (MATH1902, MATH2961): determinant and inverse of a matrix; eigenvalues and eigenvectors; linear coordinate transformations.

Analysis (Math 2962): Cauchy sequences, completeness, pointwise convergence, uniform convergence.