The University of Sydney

School of Mathematics and Statistics

MATH 2063/2963: Mathematical Computing and Nonlinear Systems (Normal/Advanced)

INFORMATION SHEET 2009

LECTURER: A/Prof Charlie Macaskill (Carslaw 627, c.macaskill@maths.usyd.edu.au). Lectures will be held at 10am on Mondays in Carslaw LT 351, and 12 noon on Tuesdays and 10 am on Wednesdays in Carslaw LT 275. You are also required to attend one tutorial and one computer lab session each week. The tutorials and laboratories start in week 2.

COURSE DESCRIPTION A description of the course is to be found in the Second Year Maths Handbook (see the Mathematics web-pages www.maths.usyd.edu.au/u/UG/IM).

COURSE OBJECTIVES

- *To obtain a basic level of computer literacy*: Manipulation of files and directories, editing of files, use of a window manager, some knowledge of the Linux operating system and the ability to undertake basic programming tasks;
- *Ability to program in MATLAB*;
- *Familiarity with the capabilities of computer algebra languages*;
- *Understanding of low-dimensional nonlinear dynamical systems both for mappings and ordinary differential equations (ODEs)*;
- *A mathematical understanding of what it means for a dynamical system to be chaotic*;
- *Modelling skills*: Ability to combine mathematical analysis and programming to solve a range of linear and nonlinear problems including those coming from practical applications;
- *Interpretation of results*: Ability to interpret numerical and mathematical results in physical terms.

Both 2063 and 2963 students will attend the same lectures and tutorials, but Advanced Level students will be expected to attempt harder assignment and examination questions needing a greater level of understanding and an acquaintance with more examples. These topics will be specified in the lectures, tutorials and assignments.

COURSE MATERIALS: A book of course materials will be available from Kopystop, Mountain Street (off Broadway). This will contain handwritten notes on nonlinear systems, some background material on the numerical solution of ODEs, a summary of MATLAB commands and the laboratory and tutorial sheets for the whole semester.

ASSESSMENT: Assessment will be by two assignments worth 10% each (due at the ends of weeks 7 and 13), two quizzes worth 5% each (the first on MATLAB in the lecture on Wednesday April 1st) and a two hour examination worth 70%.

In the assignments and exam, all students are permitted to attempt both Normal and Advanced questions; the latter will be starred. Normal students may choose to do just the unstarred

questions; however, it is usually necessary to attempt the Advanced questions in order to qualify for a High Distinction. More detailed examination information will be supplied later.

SHOULD YOU BE DOING ADVANCED OR NORMAL?

You will get more out of the course if you do it at the Advanced Level, so if you have the prerequisites, it is recommended that you enrol in the Advanced version. However, understanding the additional material does involve extra work. When making your choice, you should note the contents of the preceding paragraph.

TUTORIALS: Tutorials will be held at 12 noon in Carslaw 355 on Mondays and Eastern Avenue Seminar Room 406 on Wednesdays. Labs are in Carslaw 729/730 Tuesdays at 10am and Thursdays at 11am. Tutorials and laboratories start in Week 2. You will have been allocated one of each of these times in your personal timetable. The tutorial and lab sheets are in the course materials book.

REFERENCE BOOKS: The following two books have been placed on Special Reserve in the SciTech Library:

Lynch, S. *Dynamical Systems with Applications using MATLAB*. Birkhauser 2004.

Alligood, K, Sauer, T. & Yorke, J.A., *Chaos : An Introduction to Dynamical Systems*, Springer, 1997.

Some other useful books are:

Peitgen, H.-O., Jurgens, H. & Saupe, D., *Chaos and Fractals: New Frontiers of Science*, Springer, 1992. 516.7 333

Arrowsmith, D.K & Place, C.M., *Dynamical Systems : Differential Equations, Maps, and Chaotic Behaviour*, Chapman & Hall, 1992. 517.52 163

Drazin, P.G., *Nonlinear Systems*, Cambridge University Press (1992). 517.382 288

Sigmon, K. & Davies, T.A. *MATLAB Primer*: 6th edition. Chapman & Hall/CRC. 517.6 389 B

There are also two popular books which can be recommended for inspiration:

Gleick, James, *Chaos: Making a New Science*, Penguin (1988).

Lorenz, Edward, *The Essence of Chaos*, University of Washington Press (1993—this book is a real delight.)

WEB PAGE: This can be accessed from outside the School via

www.maths.usyd.edu.au/MATH2063

for example. The web pages will include tutorial sheets and solutions.