DEPARTMENT OF MATHEMATICS
MATHS 761: Dynamical Systems
Study Guide 2010

This document contains important information about the course Maths 761. Please read it carefully. You should keep this document for future reference.

Overview
In this course you will use analytic and numerical techniques to discover the qualitative properties of solutions to nonlinear ordinary differential equations. An important part of this is learning to choose appropriate methods for the study of each differential equation. The weekly computer laboratories are a vital and compulsory part of this course.

Preparation for the course
Before enrolling in this course, you should already have passed Maths 340 and Maths 361, or equivalent courses. The most important prerequisite material assumed is that taught in Maths 260. You should revise the material from Maths 260 before lectures start in Maths 761. Speak to your lecturer if you have any concerns about your mathematics background.

How to do well in Maths 761

- Spend about 10 hours each week working on this course, starting in the first week of classes. This includes the three hours per week required for lectures and laboratories.
- Come to all lectures and labs. If you miss a lecture, get the lecture summary from the web site and go over it before the next lecture. Note that lecture summaries contain a summary of the material covered in lectures, not a record of everything said in lectures. You may need to take some notes in class and to read about some topics in the text.
- Review the material from the previous lecture before coming to class. You should also read the recommended sections in the textbook - these are listed on the lecture summary handed out in the previous lecture.
- Prepare for laboratory sessions by going over the laboratory worksheet before coming to the laboratory and making sure you understand any necessary material from lectures.
- Try some of the recommended examples from the textbook. Examples appropriate to each lecture are listed on the lecture summaries distributed in class. Try some of the examples every week. Don't wait until it is time to study for the exam. You can only learn mathematics by doing mathematics!
- It is often helpful to discuss assignment questions with other students and with your lecturer BEFORE you hand in your assignment. Once your assignment is marked, go over it to check where you made mistakes and discuss your assignment with your lecturer.

- Not all examinable material will necessarily be covered in class, and you will need to look in the text and in other books to learn the extra material. You will be told in lectures about any topics that are examinable but not covered in lectures.

- If you are having problems with material in the course, first make sure you have read the appropriate parts of your lecture notes and the textbook. Then speak to your lecturer, either in lectures or the laboratory or by making an appointment with your lecturer for another time. Good ways to make an appointment are by speaking to your lecturer after class or by emailing your lecturer. Don't be scared to approach your lecturers for help - they are happy to help students who are trying to help themselves.

- To prepare for the exam, first make sure you understand your lecture notes and make sure you can do all assignment questions. Go over some old exam papers (these can be downloaded from the course website). The recommended problems listed in the lecture summaries can be used for extra practice. If you have problems, see your lecturer.

Text and Recommended Books

This is a graduate course; you are expected to make a real effort to find and read books and other material about the subject beyond the material given out in lectures. It is your responsibility to look for this material, not the lecturer's responsibility to provide it. The following are some suggestions of places to start, but there are many other books on Dynamical Systems in the Library, especially in sections 514.7 and 515.352.

The text for this paper is:

Stability, Instability and Chaos, by Paul Glendinning.

The course makes extensive use of the book. There is a copy of the text on short loan in the Library. The book costs about $155 new, but the bookshop may not hold many copies in stock. There may also be second hand copies of the text available, or you could try to borrow a copy from someone who took the course last year. If you cannot get access to the book speak to your lecturer.

The following books are recommended, and are available on short loan in the Kate Edger Information Commons:

1. *Nonlinear Dynamics and Chaos*, by S. Strogatz.

2. *Introduction to Applied Nonlinear Dynamical Systems*, by S. Wiggins.

3. *Chaos: An Introduction to Dynamical Systems*, by K. Alligood, T. Sauer and J. Yorke.

4. *Nonlinear Oscillations, Dynamical Systems, and Bifurcations of Vector Fields*, by J. Guckenheimer and P. Holmes.

Lecturers

The lecturers for this course are:

Dr Claire Postlethwaite: Room 414, Building 303
Email: c.postlethwaite@auckland.ac.nz
Dr Vivien Kirk (course coordinator): Room 406, Building 303
Email: v.kirk@auckland.ac.nz

Lectures and Laboratories

The class will meet at 1pm, Tuesday and Thursday in room 222 and on Friday at 1pm in the Basement Tutorial Laboratory (BTL). A map showing how to find the Tutorial Laboratory and a brief guide to the labs is given at

http://www.scl.ec.auckland.ac.nz/city_help.php?h=9

Before you come to the first laboratory session make sure you know your login and password for the computer laboratory. This should be just your usual UPI and usual password.

The laboratories are a very important part of the course, covering material that will help you with subsequent lectures and with assignments and the exam. You MUST come to the lab sessions.

Coursework

Coursework consists of four assignments, each worth 10% of your final grade. Each assignment will contain one or more questions that require you to use the computer laboratory. The assignments are substantial and will require quite a bit of time to do so start each assignment early and ask for help from your lecturer when you get stuck. You are encouraged to talk to other students about assignment questions, but the work you hand in should be your own.

Assignments will be due at 4pm on **Tuesday August 3rd, Thursday August 26th, Thursday September 30th, and Thursday October 14th**. No extensions will be given.

If illness or other problems prevent you from completing any of the assignments please contact your lecturer as soon as possible. A medical certificate will be required if you wish to apply for exemption from an assignment. If you are ill or have other problems at the time of the exam you should contact Student Health and Counselling (extn 87681) immediately to obtain information on how to apply for an aegrotat or compassionate pass.

Final Mark

The final mark for the course will be made up of 60% final exam, 40% assignments.

Calculators

Calculators are not permitted in the final exam.

Course web page
The web page for this course is

`http://www.math.auckland.ac.nz/wiki/MATHS_761_Semester_2_2010_Website`

The web page will contain copies of lecture handouts and assignments, and any important announcements. The web page will be updated often - be sure to check it frequently.

Topics covered in Maths 761
The approximate number of lectures spent on each topic is indicated in brackets.

- **Section 1:** Dynamics without parameters (12 lectures)
  - Introduction, types of behaviour/solutions.
  - Linear systems
  - Nonlinear systems, sketching phase portraits in 2D
  - Stable and unstable manifolds
  - Periodic orbits, Poincaré maps
  - Dynamics in maps, stability of fixed points in maps
  - Non-hyperbolicity and structural stability
- **Section 2:** Dynamics with parameters (12 lectures)
  - Centre manifolds
  - Local bifurcations (saddle-node, transcritical, pitchfork, Hopf)
  - Global bifurcations (homoclinic, heteroclinic)
  - Bifurcations for maps

Collaborating and Cheating
You are encouraged to discuss problems with one another and to work together on assignments, but you must not copy another person's assignment. Assignment marks contribute to the final mark you receive in this course. We view cheating on assignment work as seriously as cheating in an examination. Generally acceptable forms of collaboration include:

- Getting help in understanding from lecturers and other students.
- Discussing assignments and laboratory examples and methods of solution with other students.

Generally unacceptable forms of collaboration ("cheating") include:

- Copying all or part of another student's assignment, or allowing someone else to do all or part of your assignment for you.
- Allowing another student to copy all or part of your assignment, or doing all or part of an assignment for somebody else. This is treated as seriously as copying another student's assignment.

If you are in any doubt about the permissible degree of collaboration, then please discuss it with a staff member.

Harassment and Complaints

Complaints about assignment or tutorial marks are best made to your lecturer who is in a position to do something immediately. More general complaints can be taken up by your class representative who should be elected or appointed in the first couple of lectures. You may also approach the Head of Department or the Departmental Manager for Mathematics (telephone 373-7599 extension 88063).

Harassment on any grounds, such as racial, sexual, religious and academic is totally unacceptable. Complaints about harassment are best taken to the University Mediator (telephone 373-7599 extension 87478) or to any member of the Resolve Network whose names are displayed on posters around the campus.