University of Dundee  Division of Mathematics

MA51001 Mathematical Methods

AIMS
The aim of this course is to introduce you to some theoretical aspects of ordinary and partial differential equations and maps that will be useful in providing a background to the more applied courses offered in the Master course. The focus will therefore be on qualitative methods for studying nonlinear equations. Results concerning well-posedness, existence of solutions and positivity will form the basis of this course.

ORGANISATION
The course is given in the first teaching session and consists of 33 hours of lectures and tutorials, meeting 3 times per week for 11 weeks. This course is a Level 5, 15 SCQF module (7.5 ECTS points). Check Blackboard for details of class times and places. We will be using Blackboard for discussions, announcements, posting problems, discussion boards and general administration. So please log in on a daily basis.

The lecturer is Dr. Fordyce Davidson whose office is room J27, Floor J (i.e. 3) in the Fulton Building. He is responsible for the teaching and organisation of the course. He can be contacted on tel: 384692 or perhaps more easily by email: f.a.davidson@dundee.ac.uk

SYLLABUS

Ordinary Differential Equations
Background, existence and uniqueness, Gronwall’s inequality (4)
Hamiltonian systems (3)
Periodic solution (4)
Bifurcation and chaos (including Poincaré maps) (6)

Partial Differential Equations
Definitions, background, well-posedness (4)
Fundamental solutions of some classic equations; Green’s functions (4)
Maximum principles (2)
Nonlinear evolution equations (6)

LEARNING OBJECTIVES

Knowledge and Understanding
By the end of the course you will be expected to demonstrate a knowledge of: analysis of mathematical models using nonlinear difference equations; dynamical systems theory; chaos theory; theory and analysis of ordinary differential equations; theory and analysis of partial differential equations;
SKILLS
By the end of the course you will be expected to be able to use qualitative and quantitative mathematical techniques for the analysis and solution of nonlinear difference equations, ordinary differential equations and partial differential equations. We will make use of the Maple and Matlab software packages to complement the analytical aspects of the course.

ASSESSMENT
The course is also assessed by a three-hour degree examination at the which is taken in the December Degree Examination Diet. This will count towards 100% of your total degree mark. To pass this module will require you to score 50% or more in this exam. During the course, we will work through example problems. This will provide a mechanism by which you can judge your preparation for the exam.

STUDENT FEEDBACK
If you have any problems regarding the course, then in the first instance, you should make an appointment to see Dr. Davidson. You may also bring any matters of concern to the attention of the Staff/Student Committee, which meets each term or indeed to the Head of Division, Prof. Gunnar Hornig at any time. A list of representatives on the Staff-Student Committee will be posted on the Division Website. You will have the opportunity to make constructive comments on the course via an anonymous questionnaire, which will be handed out towards the end of the module.

RECOMMENDED TEXTS
D.S. Jones and B.D. Sleeman, Differential Equations in Mathematical Biology, (Chapman and Hall 2003 or earlier versions)