MA133-12 Differential Equations

20/21

Department
Warwick Mathematics Institute
Level
Undergraduate Level 1
Module leader
David Wood
Credit value
12
Module duration
10 weeks
Assessment
Multiple
Study location
University of Warwick main campus, Coventry

Description

Introductory description

How do you reconstruct a curve given its slope at every point? Can you predict the trajectory of a tennis ball? The basic theory of ordinary differential equations (ODEs) as covered in this module is the cornerstone of all applied mathematics. Indeed, modern applied mathematics essentially began when Newton developed the calculus in order to solve (and to state precisely) the differential equations that followed from his laws of motion.
However, this theory is not only of interest to the applied mathematician: indeed, it is an integral part of any rigorous mathematical training, and is developed here in a systematic way. Just as a `pure' subject like group theory can be part of the daily armoury of the`applied' mathematician , so ideas from the theory of ODEs prove invaluable in various branches of pure mathematics, such as geometry and topology.

[Module web page]

Module aims

To introduce simple differential and difference equations and methods for their solution, to illustrate the importance of a qualitative understanding of these solutions and to understand the techniques of phase-plane analysis.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

In this module we will cover relatively simple examples, first order equations $dy/dx=f(x,y)$, linear second order equations
\ddot{x}(t)\dot{x}+q(t)x=g(t) and coupled first order linear systems with constant coefficients, for most of which we can find an explicit solution. However, even when we can write the solution down it is important to understand what the solution means, i.e. its `qualitative' properties. This approach is invaluable for equations for which we cannot find an explicit solution.
We also show how the techniques we learned for second order differential equations have natural analogues that can be used to solve difference equations.
The course looks at solutions to differential equations in the cases where we are concerned with one- and two-dimensional systems, where the increase in complexity will be followed during the lectures. At the end of the module, in preparation for more advanced modules in this subject, we will discuss why in three-dimensions we see new phenomena, and have a first glimpse of chaotic solutions.

Learning outcomes

By the end of the module, students should be able to:

- You should be able to solve various simple differential equations (first order, linear second order and coupled systems of first order equations) and to interpret their qualitative behaviour;
- and to do the same for simple difference equations.

Indicative reading list

The primary text will be:
J. C. Robinson An Introduction to Ordinary Differential Equations, Cambridge University Press 2003.
Additional references are:
W. Boyce and R. Di Prima, Elementary Differential Equations and Boundary Value Problems, Wiley 1997.
C. H. Edwards and D. E. Penney, Differential Equations and Boundary Value Problems, Prentice Hall 2000.
K. R. Nagle, E. Saff, and D. A. Snider, Fundamentals of Differential Equations and Boundary Value Problems, Addison Wesley 1999.

Subject specific skills

See learning outcomes.

Transferable skills

Students will acquire key reasoning and problem solving skills which will empower them to address new problems with confidence.

Study

Study time

Type	Required
Lectures	30 sessions of 1 hour (25%)
Tutorials	8 sessions of 30 minutes (3%)
Private study	86 hours (72%)
Total	120 hours

Private study description

Review lectured material and work on set exercises.

Costs

No further costs have been identified for this module.

Assessment

You do not need to pass all assessment components to pass the module.

Assessment group D2

	Weighting	Study time	Eligible for self-certification
Assignments	15%		Yes (waive)
In-person Examination	85%		No

- Answerbook Pink (12 page)

Assessment group R

	Weighting	Study time	Eligible for self-certification
In-person Examination - Resit	100%		No

	Weighting	Study time	Eligible for self-certification

- Answerbook Pink (12 page)

Feedback on assessment

Marked assignments and exam feedback.

[Past exam papers for MA133]

Availability

Courses

This module is Core for:

- Year 1 of UMAA-G100 Undergraduate Mathematics (BSc)
- UMAA-G103 Undergraduate Mathematics (MMath)
  - Year 1 of G100 Mathematics
  - Year 1 of G103 Mathematics (MMath)
- Year 1 of UMAA-G106 Undergraduate Mathematics (MMath) with Study in Europe
- Year 1 of UMAA-G1NC Undergraduate Mathematics and Business Studies
- Year 1 of UMAA-G1N2 Undergraduate Mathematics and Business Studies (with Intercalated Year)
- Year 1 of UMAA-GL11 Undergraduate Mathematics and Economics
- Year 1 of UECA-GL12 Undergraduate Mathematics and Economics (with Intercalated Year)
- Year 1 of UMAA-GV17 Undergraduate Mathematics and Philosophy
- Year 1 of UMAA-GV18 Undergraduate Mathematics and Philosophy with Intercalated Year
- Year 1 of UPXA-FG33 Undergraduate Mathematics and Physics (BSc MMathPhys)
- Year 1 of UPXA-GF13 Undergraduate Mathematics and Physics (BSc)
- UPXA-FG31 Undergraduate Mathematics and Physics (MMathPhys)
  - Year 1 of GF13 Mathematics and Physics
  - Year 1 of FG31 Mathematics and Physics (MMathPhys)
- Year 1 of UMAA-G101 Undergraduate Mathematics with Intercalated Year

This module is Optional for:

- Year 1 of USTA-G1G3 Undergraduate Mathematics and Statistics (BSc MMathStat)
- Year 1 of USTA-GG14 Undergraduate Mathematics and Statistics (BSc)