

# MA133-10 Differential Equations

26/27

**Department**

Warwick Mathematics Institute

**Level**

Undergraduate Level 1

**Module leader**

Lukas Eigentler

**Credit value**

10

**Module duration**

10 weeks

**Assessment**

Multiple

**Study location**

University of Warwick main campus, Coventry

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## Description

### Introductory description

It is a far stream version of the new  $M^3-1$  and  $M^3-2$  (MA144, MA145, MA146, MA147) module that allows students access to differential equations (ODEs and PDEs) in year 2. It covers the differential equations topics covered in these modules as well as foundations of differentiable calculus.

### Module aims

To introduce simple differential and difference equations, methods for their solution, and foundations of differential calculus.

### 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.

1. First order linear equations: first order linear equations, examples of existence and uniqueness, integration techniques (integrating factors, ...).
2. Second order equations: general homogeneous equations and linear second order equations with constant coefficients, reduction to  $2 \times 2$  systems, sketching the flow under a

- vector field (2d only, phase diagrams).
3. Nonlinear equations and 2x2 systems: linear stability such as predator and prey models.
  4. Discretisation techniques: explicit and implicit Euler, stability (optional).
  5. Differential calculus of scalar functions of several variables: partial derivative, chain rule, change of coordinates, gradient, directional derivative.
  6. Differential calculus of vector functions of several variables: crossed product, vector fields, divergence, curl, nabla, algebraic identities, Laplace, expression in other coordinates (polar, cylindrical, spherical), parametrisation of surfaces, tangent planes, normal
  7. Integration: 2D-divergence theorem.

## 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

[Reading lists can be found in Talis](#)

## 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.

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## Study

### Study time

| Type          | Required                      |
|---------------|-------------------------------|
| Lectures      | 20 sessions of 1 hour (20%)   |
| Tutorials     | 8 sessions of 30 minutes (4%) |
| Private study | 76 hours (76%)                |
| Total         | 100 hours                     |

## Private study description

Review lectured material and work on set exercises.

## Costs

No further costs have been identified for this module.

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## Assessment

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

Students can register for this module without taking any assessment.

### Assessment group D

|                                              | Weighting | Study time | Eligible for self-certification |
|----------------------------------------------|-----------|------------|---------------------------------|
| Assignments                                  | 15%       |            | No                              |
| Centrally-timetabled examination (On-campus) | 85%       |            | No                              |

- Answerbook Pink (12 page)

### Assessment group R

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

- Answerbook Pink (12 page)

## Feedback on assessment

Marked assignments and exam feedback.

[Past exam papers for MA133](#)

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## Availability

### Anti-requisite modules

If you take this module, you cannot also take:

- MA147-10 Mathematical Methods and Modelling 1
- MA145-10 Mathematical Methods and Modelling 2
- MA144-10 Methods of Mathematical Modelling 2
- MA146-10 Methods of Mathematical Modelling 1

## Courses

This module is Optional for:

- Year 1 of USTA-G300 Undergraduate Master of Mathematics, Operational Research, Statistics and Economics
- Year 1 of USTA-G1G3 Undergraduate Mathematics and Statistics (BSc MMathStat)
- Year 1 of USTA-GG14 Undergraduate Mathematics and Statistics (BSc)
- Year 1 of USTA-Y602 Undergraduate Mathematics, Operational Research, Statistics and Economics

This module is Option list A for:

- Year 1 of UCSA-G4G1 Undergraduate Discrete Mathematics
- UCSA-G4G3 Undergraduate Discrete Mathematics
  - Year 1 of G4G1 Discrete Mathematics
  - Year 1 of G4G3 Discrete Mathematics

This module is Option list B for:

- Year 1 of UCSA-G4G1 Undergraduate Discrete Mathematics
- UCSA-G4G3 Undergraduate Discrete Mathematics
  - Year 1 of G4G1 Discrete Mathematics
  - Year 1 of G4G3 Discrete Mathematics