MA4H0-15 Applied Dynamical Systems

21/22

Department
> Warwick Mathematics Institute

Level
> Undergraduate Level 4

Module leader
> Robert MacKay

Credit value
> 15

Module duration
> 10 weeks

Assessment
> Multiple

Study location
> University of Warwick main campus, Coventry

Description

Introductory description

This course will introduce and develop the notions underlying the geometric theory of dynamical systems and ordinary differential equations.

[Module web page](#)

Module aims

This course will introduce and develop the notions underlying the geometric theory of dynamical systems and ordinary differential equations. Particular attention will be paid to ideas and techniques that are motivated by applications in a range of the physical, biological and chemical sciences. In particular, motivating examples will be taken from chemical reaction network theory, climate models, fluid motion, celestial mechanics and neuronal dynamics.

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.

The module will be structured around the following topics:

- Review of basic theory: flows, notions of stability, linearization, phase portraits, etc;
- `Solvable' systems: integrability and gradient structure, applications in celestial mechanics and chemical reaction networks;
- Invariant manifold theorems: stable, unstable and center manifolds;
- Bifurcation theory from a geometric perspective;
- Compactification techniques: flow at infinity, blow-up, collision manifolds;
- Chaotic dynamics: horsehoes, Melnikov method and discussion of strange attractors;
- Singular perturbation theory: averaging and normally hyperbolic manifolds.

Learning outcomes

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

- See outline syllabus.

Subject specific skills

See outline syllabus

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 (20%)
Tutorials	9 sessions of 1 hour (6%)
Private study	111 hours (74%)
Total	150 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 B1

	Weighting	Study time	Eligible for self-certification
In-person Examination	100%		No
3 hour exam, no books allowed			

- Answerbook Gold (24 page)

Assessment group R

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

- Answerbook Gold (24 page)

Feedback on assessment

Exam feedback

[Past exam papers for MA4H0](#)

Availability

Courses

This module is Optional for:

- Year 1 of TMAA-G1PE Master of Advanced Study in Mathematical Sciences
- Year 1 of TMAA-G1PD Postgraduate Taught Interdisciplinary Mathematics (Diploma plus MSc)
- Year 1 of TMAA-G1P0 Postgraduate Taught Mathematics
- Year 1 of TMAA-G1PC Postgraduate Taught Mathematics (Diploma plus MSc)

This module is Option list A for:

- Year 2 of TMAA-G1PD Postgraduate Taught Interdisciplinary Mathematics (Diploma plus MSc)

- Year 2 of TMAA-G1PC Postgraduate Taught Mathematics (Diploma plus MSc)
- Year 4 of USTA-G1G3 Undergraduate Mathematics and Statistics (BSc MMathStat)

This module is Option list B for:

- Year 2 of TMAA-G1PD Postgraduate Taught Interdisciplinary Mathematics (Diploma plus MSc)
- Year 2 of TMAA-G1PC Postgraduate Taught Mathematics (Diploma plus MSc)
- Year 3 of USTA-G1G3 Undergraduate Mathematics and Statistics (BSc MMathStat)

This module is Option list C for:

- UMAA-G105 Undergraduate Master of Mathematics (with Intercalated Year)
  - Year 3 of G105 Mathematics (MMath) with Intercalated Year
  - Year 5 of G105 Mathematics (MMath) with Intercalated Year
- UMAA-G103 Undergraduate Mathematics (MMath)
  - Year 3 of G103 Mathematics (MMath)
  - Year 4 of G103 Mathematics (MMath)
- UMAA-G106 Undergraduate Mathematics (MMath) with Study in Europe
  - Year 3 of G106 Mathematics (MMath) with Study in Europe
  - Year 4 of G106 Mathematics (MMath) with Study in Europe