Module Specification

Dynamical Systems

Version: 2023-24, v2.0, 07 Jun 2023

Contents

Part 1: Information

Module title: Dynamical Systems

Module code: UFMFTV-15-3

Level: Level 6

For implementation from: 2023-24

UWE credit rating: 15

ECTS credit rating: 7.5

Faculty: Faculty of Environment & Technology

Department: FET Dept of Computer Sci & Creative Tech

Partner institutions: None

Field: Computer Science and Creative Technologies

Module type: Module

Pre-requisites: Calculus and Numerical Techniques 2021-22, Mathematical Structures 2023-24

Excluded combinations: None

Co-requisites: None

Continuing professional development: No

Professional, statutory or regulatory body requirements: None

Part 2: Description

Overview: The module will develop modern Dynamical Systems theory which has become one of the most powerful and useful mathematical theories since its initial development by Henri Poincare at the end of the 19th century. The theory will be developed for nonlinear, continuous-time dynamical systems arising from autonomous ordinary differential equations (ODEs).

The theory and techniques developed within this module continue to underpin contemporary work being conducted at the forefront of scientific research. They enable the mathematical scientist to investigate, understand and predict a huge range of modern applied problems in the physical, life and social sciences, as well as other areas within mathematics.

Problems arising from applications will motivate the development of the theory. These may come from the natural and social sciences (e.g. biology, physics, engineering, economics). In particular, the research interests of academic staff will be reflected in the module content. The specific nature of the applications may therefore vary from year to year according to the make-up of the module team.

Throughout the module, connections will be made between the underlying mathematical concepts and techniques and their applicability for analysing and understanding real-world problems.

Features: Not applicable

Educational aims: To introduce students to the mathematical formulation, description and applicability of modern dynamical systems theory.

Outline syllabus: Motivating examples and applications; existence and uniqueness theory; linearity and nonlinearity; monotonicity; equilibrium points; linearization; stability of equilibrium points; asymptotic behaviour; semi-flows and phase space; dependence upon parameters; bifurcation theory; existence and stability of limit cycles.

Part 3: Teaching and learning methods

Teaching and learning methods: Teaching will be delivered by means of lectures, tutorials, problems classes and computer lab sessions (where appropriate). Software packages may be used as both a teaching and learning aid, to visualize and describe particular behaviours exhibited by dynamical systems.

Scheduled teaching hours will take the form of:

whole-group lectorials, used to present new material, consolidated via worked examples;
Smaller-group tutorials, with activities designed to reinforce mathematical skills or to provide an arena for students to work together, ask individual questions and obtain mathematical help & support.

Independent learning includes engagement with essential reading and the Written Assignment.

Module Learning outcomes: On successful completion of this module students will achieve the following learning outcomes.

MO1 Communicate logical arguments, techniques and results clearly and effectively in written form using appropriate mathematical notation and language

MO2 Select and apply appropriate techniques to determine the long-term behaviour of a given dynamical system

MO3 Select and apply appropriate techniques to determine the behaviour of a given dynamical system under parameter variation

MO4 Interpret appropriate analyses in the context of dynamical systems theory and/or in an areas of application

Hours to be allocated: 150

Contact hours:

Independent study/self-guided study = 114 hours

Face-to-face learning = 36 hours

Total = 150

Reading list: The reading list for this module can be accessed at readinglists.uwe.ac.uk via the following link https://rl.talis.com/3/uwe/lists/F9763AC0-A278-3E16-09CB-812831433E83.html?draft=1&lang=en-US&login=1

Part 4: Assessment

Assessment strategy: Students are expected to undertake self-directed learning in addition to the directed learning which supports taught classes. This learning will be essential for the Written Assignment, which may require students to undertake additional reading beyond that associated with lectures.

The Assignment will assess the student's technical and communication skills by applying theoretical concepts and techniques to a relevant applied problem and presenting their results in written form, possibly including output from appropriate numerical software.

Student's will be provided with a written brief, outlining the mathematical and applied problems to be addressed in the Written Assignment. The Assignment will be designed so that students are able to work on it incrementally as the module progresses, over several weeks, submitting their work at the end of the teaching block (or soon afterwards). In so doing we will be able to explore concepts more deeply and encourage greater individuality and creativity in student work. It will also enable students to manage their time and workload more effectively.

The resit assessment will be a new assignment, of a similar format to the First Sit.

Assessment tasks:

Written Assignment (First Sit)
Description: To assess understanding and assimilation of fundamental concepts, theories and techniques and to utilise them in some domain of application (which may include other branches of mathematics).
Students will be able to work on the assignment over several weeks as the relevant material is developed.
Weighting: 100 %
Final assessment: Yes
Group work: No
Learning outcomes tested: MO1, MO2, MO3, MO4

Written Assignment (Resit)

Description: As per First Sit.

Weighting: 100 %

Final assessment: No

Group work: No

Learning outcomes tested: MO1, MO2, MO3, MO4

Part 5: Contributes towards

This module contributes towards the following programmes of study:

Mathematics [Sep][FT][Frenchay][3yrs] BSc (Hons) 2021-22

Mathematics {Foundation}[Sep][FT][Frenchay][4yrs] BSc (Hons) 2020-21

Mathematics [Sep][SW][Frenchay][4yrs] BSc (Hons) 2020-21

Mathematics [Sep][SW][Frenchay][4yrs] BSc (Hons) 2020-21

Mathematics {Foundation} [Sep][SW][Frenchay][5yrs] BSc (Hons) 2019-20