Module Specification

Applications of Computational Mathematics

Version: 2028-29, v3.0, Approved

Contents

Part 1: Information

Module title: Applications of Computational Mathematics

Module code: UFMFVV-30-3

Level: Level 6

For implementation from: 2028-29

UWE credit rating: 30

ECTS credit rating: 15

College: College of Arts, Technology and Environment

School: CATE School of Computing and Creative Technologies

Partner institutions: None

Field: Computer Science and Creative Technologies

Module type: Module

Pre-requisites: None

Excluded combinations: None

Co-requisites: None

Continuing professional development: No

Professional, statutory or regulatory body requirements: None

Part 2: Description

Overview: The continually increasing involvement of computers in the modern world has driven the importance of computational mathematics – the design, development and analysis of mathematical algorithms – as a subject. This module builds on the coverage of computational mathematics and methods from previous levels in the mathematics programme. This module will provide broader and deeper coverage of computational mathematics and will include both theory and applications of the subject. Students will investigate problems, methods and techniques from this field,

specifically the areas of numerical linear algebra and numerical optimisation. Students will consider applications, formulate algorithms and investigate properties of the algorithms such as convergence, stability and computational complexity.

Features: Not applicable

Educational aims: The aims of this module are to facilitate the student in their further development of the theory and techniques of computational mathematics and also to deepen their understanding of the importance of the subject in the modern world. Students will encounter problems, motivated by real-world applications, which involve the implementation, analysis and evaluation of mathematical algorithms. The motivational applications will be sourced from a wide range of fields, such as machine learning, image and signal processing, simulation, mathematical modelling of physics, and scientific computation. In their studies of algorithms, students will further enhance their knowledge and skills of computer programming.

Outline syllabus: The following syllabus is indicative. The coverage of these topics will include their theory and analysis, applications to real-world problems and their computer implementation.

Numerical Solutions for Boundary Value Partial Differential Equations (PDEs).
Numerical Linear Algebra.
Discrete Transforms.
Numerical Optimisation.

Part 3: Teaching and learning methods

Teaching and learning methods: The module's scheduled teaching hours will take the following form:

whole group lectures used to deliver new material and to consolidate previous material;

small group classroom tutorials with activities designed to reinforce and enhance students' understanding of the lecture material;

small group computing laboratory sessions designed to develop the students' ability to generate and utilise computer algorithms and to analyse their output and review their performance;

informal student-led drop-in sessions to enable students to discuss their work with themselves and/or an academic.

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

MO1 Design, construct, and justify appropriate algorithms to solve compound problems in computational mathematics.

MO2 Analyse computational methods, both theoretically and empirically, for error convergence, stability, and complexity.

MO3 Create, develop, and evaluate tests for the performance of algorithms using a computer programming environment.

MO4 Interpret, assess, and communicate the results arising from the implementation of computational mathematics methods.

Hours to be allocated: 300

Contact hours:

Independent study/self-guided study = 228 hours

Face-to-face learning = 72 hours

Reading list: The reading list for this module can be accessed at readinglists.uwe.ac.uk via the following link https://uwe.rl.talis.com/modules/ufmfvv-30-3.html

Part 4: Assessment

Assessment strategy: There will be two assessment tasks in this module, using a range of different assessment techniques. The tasks are designed to assess the practical skills and theoretical knowledge required of a computational mathematician.

The first assessment task will be an examination at the end of the first semester. This exam will cover the topics of Discrete Transforms and Numerical Optimisation. The exam will, at least in part, be part-seen which will enable the students to perform analysis in preparation for the exam. This assessment will focus on theoretical analysis, error convergence, stability, and complexity.

The second assessment will be a written coursework under the topic of Numerical Linear Algebra. This assignment will provide students the opportunity to investigate the application of computational methods to specific problems. The assignment will result in a design and construction of computer code and a written report on the implementation, analysis and evaluation of the code. The report will include justification of chosen method(s) and will focus on the design, implementation and communication of methods in Linear Algebra.

Formative assessment will be conducted via weekly tasks that provide ongoing feedback both to students and to module teams, thereby allowing for timely adjustments to teaching strategies, and enabling students to monitor their progress and to address learning gaps before summative assessments take place.

The resit assessment will match the first sit.

Assessment tasks:

Examination (First Sit)
Description: Written examination (3 hours)
Weighting: 50 %
Final assessment: No
Group work: No
Learning outcomes tested: MO1, MO2, MO4

Report (First Sit)
Description: 10 page report including code
Weighting: 50 %

Final assessment: Yes
Group work: No
Learning outcomes tested: MO1, MO3, MO4

Examination (Resit)
Description: Written examination (3 hour)
Weighting: 50 %
Final assessment: No
Group work: No
Learning outcomes tested: MO1, MO2, MO4

Report (Resit)
Description: 10 page report including code
Weighting: 50 %
Final assessment: Yes
Group work: No
Learning outcomes tested: MO1, MO3, MO4

Part 5: Contributes towards

This module contributes towards the following programmes of study:

Mathematics {Foundation} [Frenchay] - WITHDRAWN BSc (Hons) 2024-25

Mathematics [Frenchay] BSc (Hons) 2025-26

Mathematics [Frenchay] BSc (Hons) 2026-27

Mathematics [Frenchay] BSc (Hons) 2026-27