Module Specification

Applications of Computational Mathematics

Version: 2023-24, v2.0, 15 May 2023

Contents

Part 1: Information

Module title: Applications of Computational Mathematics

Module code: UFMFVV-30-3

Level: Level 6

For implementation from: 2023-24

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: Calculus and Numerical Analysis 2022-23

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. We 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 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 empically, 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

Total = 300

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/lists/C1D63717-3213-D40D-6620-350A2C704CC8.html

Part 4: Assessment

Assessment strategy: There will be two assessment tasks in this module, using a range of different assessment techniques.

To assess the student's early understanding of producing computer code and to perform analysis of the results and performance, there will a formative assessment early in the first teaching block. This will involve a programming task designed to support the students' future learning, in particular for the first assessment point.

Early in the second semester there will be a written coursework the topic of Numerical Linear Algebra. This assignment will be a short piece of work designed to 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) as part of a critical review of the work. This assignment, by nature, will be less prescriptive than the in-class programming assessment with, for example, the student being given a general set of objectives as a specification.

The second assessment task will be an end-of-year examination. 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 of algorithms in these two fields as preparation for the exam.

All assessments will require students to demonstrate both practical skills and theoretical knowledge of a computational mathematician.

Assessment tasks:

Report (First Sit)
Description: 10 page report including code
Weighting: 50 %
Final assessment: No
Group work: No
Learning outcomes tested: MO1, MO2, MO3, MO4

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

Report (Resit)
Description: 10 page report including code
Weighting: 50 %
Final assessment: No
Group work: No
Learning outcomes tested: MO1, MO2, MO3, MO4

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

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