Module Specification

Numerical Analysis

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Contents

Module Specification **1**

Part 1: Information **2**

Part 2: Description **2**

Part 3: Teaching and learning methods **4**

Part 4: Assessment **5**

Part 5: Contributes towards **7**

Part 1: Information

Module title: Numerical Analysis

Module code: UFMFX9-30-3

Level: Level 6

For implementation from: 2023-24

UWE credit rating: 30

ECTS credit rating: 15

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: Mathematical Methods 2023-24

Excluded combinations: None

Co-requisites: None

Continuing professional development: No

Professional, statutory or regulatory body requirements: None

Part 2: Description

Overview: Not applicable

Features: Not applicable

Educational aims: "Numerical Analysis is the study of algorithms for the problems of continuous mathematics" – L.N.Trefethen.

This module will introduce a number of numerical methods for the solution of a range

of mathematical problems. Numerical methods are methods in mathematics that solve problems for which there is, typically, no analytical method of solution. The subsequent analysis of the numerical methods considers:

Stability analysis – will the method actually supply useful results at the end,

Efficiency – how much time and space does the method need,

Consistency – will the method actually solve what we think it is solving,

Error analysis – how accurate will the end results be.

Real world problems are often too complicated to be solved analytically. Hence, numerical methods, and their subsequent analysis, are widely used in industry.

Outline syllabus: It is assumed in the delivery of this module that the following methods have been covered at level 2:

Newton method for one variable.
Lagrange interpolation.
Trapezium rule.
Euler's method.

The syllabus content for the module will cover numerical methods in the following fields and in each case will include an introduction, derivation and analysis of these methods. As appropriate, the analysis will include the topics of accuracy, efficiency, convergence and stability.

Solving Equations:
Bisection method.
Fixed point iteration.
Secant method.

Solving Systems of Equations:

Direct methods.
Iterative methods.
Newton’s method.

Numerical Differentiation and Integration:
Finite difference method
Newton-Cotes formulae
Gaussian quadrature

Ordinary Differential Equations:
Initial value problems.
RK-type and multi-step schemes
Improvements to schemes – e.g. adaptive time-steps.
Boundary value problems.

Partial Differential Equations:
Finite difference scheme applied to elliptic, parabolic and hyperbolic problems.
Explicit and implicit schemes.
Regular and irregular grids.
Implementation of Neumann and Robin boundary conditions.

Part 3: Teaching and learning methods

Teaching and learning methods: The module is delivered by means of lectures, tutorials and computing laboratory sessions. Attendance at all classes will be strongly encouraged, both in terms of learning and also as part of assessment preparation. To prepare for assessment, students are expected to undertake self-directed learning in addition to the directed learning which supports taught classes.

Typically the scheduled teaching hours take the form of:
(i) Whole group lectures, used to deliver new material and to consolidate previous material, and
(ii) (ii) Small-group classroom tutorials with activities designed to reinforce and

enhance students' understanding of the lecture material.
(iii) (iii) Small-group computing laboratory sessions designed to develop the students' ability to generate and utilise software and to analyse software output.

Contact time 72 hours
Assimilation and development of knowledge 150 hours
Coursework preparation 22 hours
Examination preparation 56 hours
TOTAL 300 HOURS

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

MO1 Read and understand a description of a numerical method and be able to implement the method, both by hand and by software development

MO2 Derive and analyse a numerical method

MO3 Interpret the results of a numerical method, including a critical evaluation of the method's performance

MO4 Identify suitable types of numerical methods for the solution of particular mathematical problems.

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/modules/ufmfx9-30-3.html

Part 4: Assessment

Assessment strategy: The assessment strategy for this module comprises a written examination (Component A) and a Numerical Analysis Assignment (Component B). The end-of-module examination is summative and tests students' ability to bring together concepts and techniques from the whole module and select appropriate solution techniques to the solution of mathematical problems that arise in numerical analysis problems with interpretation of the results.

The numerical analysis assignment will involve working with software. Students will build on and adapt template code used in class to address a more challenging problem. This will involve computer programming, interpreting computer outputs and/or performing a critical review of the methods used.

Assessment tasks:

Examination (Online) - Component A (First Sit)
Description: Online Written examination
Weighting: 50 %
Final assessment: Yes
Group work: No
Learning outcomes tested: MO1, MO2, MO4

Written Assignment - Component B (First Sit)
Description: Numerical analysis assignment (max 20 pages including code)
Weighting: 50 %
Final assessment: No
Group work: No
Learning outcomes tested: MO1, MO3, MO4

Examination (Online) - Component A (Resit)
Description: Online Written examination
Weighting: 50 %
Final assessment: Yes
Group work: No
Learning outcomes tested: MO1, MO2, MO4

Written Assignment - Component B (Resit)

Description: Numerical analysis assignment (max 20 pages including code)

Weighting: 50 %

Final assessment: No

Group work: No

Learning outcomes tested: MO1, MO3, MO4

Part 5: Contributes towards

This module contributes towards the following programmes of study:

Mathematics [Sep][FT][Frenchay][4yrs] - Not Running MMath 2021-22

Mathematics [Sep][SW][Frenchay][5yrs] - Not Running MMath 2020-21

Mathematics and Statistics [Sep][SW][Frenchay][4yrs] - Not Running BSc (Hons) 2020-21

Mathematics and Statistics {Foundation} [Sep][FT][Frenchay][4yrs] - Not Running BSc (Hons) 2020-21

Mathematics {Foundation} [Sep][FT][Frenchay][4yrs] - Not Running BSc (Hons) 2020-21

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