University of the West of Scotland

Module Descriptor

Session: 2024/25

Title of Module: Numerical Analysis 2			
Code: MATH09011	**SCQF Level: 9 (Scottish Credit and Qualifications Framework)**	**Credit Points: 20**	**ECTS: 10 (European Credit Transfer Scheme)**
School:	School of Computing Engineering and Physical Sciences		
Module Co-ordinator:	Dr Wan R. Mekwi		

Summary of Module

This module builds on the concept of an ordinary differential equation as introduced in the level 8 module Differential Equations 1. The ethos of the approach taken is underpinned by the fact that most ordinary differential equations cannot be solved analytically in terms of standard functions, thereby leading to the study of numerical methods of solution.

The basic idea of numerical solution of first order equations is introduced using Euler's method, and extended to cover a range of other methods, including Modified and Improved Euler's methods, linear multistep methods and Runge-Kutta methods.

Finite difference methods for initial and boundary value problems will be discussed.

Issues of consistency and convergence are investigated across the range of numerical methods discussed above. A treatment of error analysis in such problems will be given.

The implementation of these solution methods will be supported by suitable mathematical software.

The Graduate Attributes relevant to this module are given below:

- Academic: Critical thinker; Analytical; Inquiring; Knowledgeable; Problem-solver; Digitally literate; Autonomous.
- Personal: Motivated; Resilient
- Professional: Ambitious; Driven.

Module Delivery Method

Face-To-Face	Blended	Fully Online	HybridC	Hybrid 0	Work-Based Learning
☒	☐	☐	☐	☐	☐

See Guidance Note for details.

Campus(es) for Module Delivery						
The module will **normally** be offered on the following campuses / or by Distance/Online Learning: (Provided viable student numbers permit) (tick as appropriate)						
Paisley:	Ayr:	Dumfries:	Lanarkshire:	London:	Distance/Online Learning:	Other:
☒	☐	☐	☐	☐	☐	Add name

Term(s) for Module Delivery					
(Provided viable student numbers permit).					
Term 1	☐	Term 2	☒	Term 3	☐

Learning Outcomes: (maximum of 5 statements) **These should take cognisance of the SCQF level descriptors and be at the appropriate level for the module.** At the end of this module the student will be able to:	
L1	Implement numerical solution methods for ordinary differential equations.
L2	Perform error analysis, stability, consistency and convergence of numerical methods.
L3	Apply finite difference methods to solve initial and boundary value problems.

Employability Skills and Personal Development Planning (PDP) Skills	
SCQF Headings	During completion of this module, there will be an opportunity to achieve core skills in:
Knowledge and Understanding (K and U)	SCQF Level **9** Demonstrating a detailed knowledge and understanding of important techniques necessary in the analysis of numerical methods for solving ordinary differential equations. Demonstrating critical awareness of established techniques in solving ordinary differential equations numerically.
Practice: Applied Knowledge and Understanding	SCQF Level **9** Using a range of standard techniques to solve problems at an advanced level, sometimes in non-routine contexts. Carrying out defined investigative problems within a mathematically based subject.
Generic Cognitive skills	SCQF Level **9** Conceptualising and analysing problems informed by professional and research issues.

Communication, ICT and Numeracy Skills	SCQF Level **9** Implementing and interpreting suitable mathematical software. Making formal written presentation(s) based on the output from an investigative problem.	
Autonomy, Accountability and Working with others	SCQF Level **9** Exercising independence and initiative in carrying out a range of activities. Identifying learning needs through reflection based on self, tutor and peer evaluation of work.	
Pre-requisites:	Before undertaking this module the student should have undertaken the following:	
	Module Code: MATH08002 MATH08008	**Module Title:** Differential Equations 1 Multivariable Calculus
	Other:	
Co-requisites	**Module Code:**	**Module Title:** Numerical Analysis

*Indicates that module descriptor is not published.

Learning and Teaching	
In line with current learning and teaching principles, a 20-credit module includes 200 learning hours, normally including a minimum of 36 contact hours and maximum of 48 contact hours.	
Learning Activities During completion of this module, the learning activities undertaken to achieve the module learning outcomes are stated below:	**Student Learning Hours** (Normally totalling 200 hours): (Note: Learning hours include both contact hours and hours spent on other learning activities)
Lecture/Core Content Delivery	36
Laboratory/Practical Demonstration/Workshop	12
Independent Study	152
	200 Hours Total
****Indicative Resources: (eg. Core text, journals, internet access)**	

The following materials form essential underpinning for the module content and ultimately for the learning outcomes:

K. Atkinson, W. Han, and D. E. Stewart, Numerical solution of ordinary differ- ential equations, John Wiley & Sons, 2011.

B. Bradie, A friendly introduction to numerical analysis, Pearson Education India, 2006.

T. A. Driscoll and R. J. Braun, Fundamentals of Numerical Computation, vol. 154, Siam, 2017.

(**N.B. Although reading lists should include current publications, students are advised (particularly for material marked with an asterisk*) to wait until the start of session for confirmation of the most up-to-date material)

Attendance and Engagement Requirements

In line with the Student Attendance and Engagement Procedure: Students are academically engaged if they are regularly attending and participating in timetabled on-campus and online teaching sessions, asynchronous online learning activities, course-related learning resources, and complete assessments and submit these on time.

Equality and Diversity

The University's Equality, Diversity and Human Rights Procedure can be accessed at the following link: UWS Equality, Diversity and Human Rights Code.

(N.B. Every effort will be made by the University to accommodate any equality and diversity issues brought to the attention of the School)

Supplemental Information

Divisional Programme Board	Engineering and Physical Sciences
Assessment Results (Pass/Fail)	Yes ☐No ☒
School Assessment Board	Computing, Engineering and Physical Sciences
Moderator	Dr Alan Walker
External Examiner	P. Wilson
Accreditation Details	

Changes/Version Number	Slight change to Learning Outcomes. Change of module moderator. Slight change to assessment components. Title change. Update to co-requisites. Change to prerequisites.

Assessment: (also refer to Assessment Outcomes Grids below)
Assessment 1 – Portfolio of written and computer work (40%)
Assessment 2 – Class test: formal unseen assessment (60%)
(N.B. (i) **Assessment Outcomes Grids** for the module (one for each component) can be found below which clearly demonstrate how the learning outcomes of the module will be assessed. (ii) An **indicative schedule** listing approximate times within the academic calendar when assessment is likely to feature will be provided within the Student Module Handbook.)

Assessment Outcome Grids (See Guidance Note)

Component 1							
Assessment Type (Footnote B.)	**Learning Outcome (1)**	**Learning Outcome (2)**	**Learning Outcome (3)**	**Learning Outcome (4)**	**Learning Outcome (5)**	**Weighting (%) of Assessment Element**	**Timetabled Contact Hours**
Portfolio	✓	✓	✓			40	

Component 2							
Assessment Type (Footnote B.)	**Learning Outcome (1)**	**Learning Outcome (2)**	**Learning Outcome (3)**	**Learning Outcome (4)**	**Learning Outcome (5)**	**Weighting (%) of Assessment Element**	**Timetabled Contact Hours**
Class test (unseen, closed book)	✓	✓	✓			60	2

Combined Total for All Components	100%	2 hours