University of the West of Scotland

Module Descriptor

Session: 2024/25

Title of Module: Mathematical Biology			
Code: MATH10010	**SCQF Level: 10 (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 Alan Walker		

Summary of Module

The module covers the mathematical modelling of biological phenomena.

Students will begin to understand why ordinary differential equations (ODEs) can arise in modelling biological phenomena. One-dimensional autonomous ODEs will be covered, including a treaty on equilibrium points, stability, phase plots, and linear stability analysis within the context of mathematical biology.

These ideas will be expanded to consider systems of two or more ODEs, paying attention to equilibria and the stability thereof, phase plane analysis, and linear stability analysis, within the context of interacting species and/or disease modelling.

Biological movement and pattern formation will be introduced, with mention made to chemical diffusion, chemotaxis, reaction-diffusion equations, Turing patterns and diffusion-driven instability.

Travelling waves will be touched upon, with regard to Fisher's equation, wound healing and epidemiology. Further, the modelling of infectious diseases will be covered, with an introduction to SIR models, the Kermack-McKenzie model, steady-states and linear stability.

Reaction kinetics will be studied, including the Law of Mass Action, enzyme reactions, the pseudo steady-state hypothesis, and singular perturbation techniques.

Finally, discrete time population models will be introduced, via difference equations models for seasonally reproducing organisms, harvesting, obtaining maximum sustainable yields, Leslie matrices and the Jury conditions for stability.

The Graduate Attributes relevant to this module are given below:

- Academic: Critical thinker; Analytical; Inquiring; Knowledgeable; Problem-solver; Digitally literate; Autonomous.
- Personal: Motivated, Creative; Resilient.

Professional: Research-minded; 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	Demonstrate detailed knowledge and understanding of equilibria and stability in ODE models of biological phenomena
L2	Demonstrate detailed knowledge and understanding of the mathematics involved in biological movement and pattern formation.
L3	Demonstrate detailed knowledge and understanding of mathematical modelling of reaction kinetics.
L4	Demonstrate detailed knowledge and understanding of discrete time population models.

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 **10** Demonstrating a detailed knowledge and understanding of important techniques used in creating and analysing models which arise in biological phenomena. Demonstrating critical awareness of established techniques of enquiry

	in common biological applications of differential equations and difference equations.	
Practice: Applied Knowledge and Understanding	SCQF Level **10** Using a range of standard techniques to analyse and solve problems at advanced levels, and sometimes in non-routine contexts. Carrying out defined investigative problems within a mathematically based subject.	
Generic Cognitive skills	SCQF Level **10** Conceptualising and analysing problems informed by professional and research issues.	
Communication, ICT and Numeracy Skills	SCQF Level **10** Making formal written presentation(s) based on the output from an investigative problem.	
Autonomy, Accountability and Working with others	SCQF Level **10** Exercising independence and initiative in carrying out complex 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: MATH09002	**Module Title: Differential Equations 2**
	Other:	Or equivalent
Co-requisites	**Module Code:**	**Module Title:**

*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	24

Tutorial/Synchronous Support Activity	12
Independent Study	164
	Hours Total 200

****Indicative Resources: (eg. Core text, journals, internet access)**

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

Essential Mathematical Biology: 1st Edition, N Britton, 2003, Springer.

"Mathematical Biology" class notes as published on the University VLE.

Mathematical Biology: 3rd Edition, J D Murray, 2013, Springer.

Mathematical Aspects of Reacting and Diffusing Systems: 1st Edition, P C Fife, 1979, Springer.

Please ensure the list is kept short and current. Essential resources should be included, broader resources should be kept for module handbooks / Aula VLE.

Resources should be listed in Right Harvard referencing style or agreed professional body deviation and in alphabetical order.

(**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.

Please ensure any specific requirements are detailed in this section. Module Co-ordinators should consider the accessibility of their module for groups with protected characteristics..

(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 Wan Mekwi
External Examiner	C. Guiver
Accreditation Details	
Changes/Version Number	1.03 Moderator changed to Wan Mekwi Assessment component (20%) changed to Coursework

Assessment: (also refer to Assessment Outcomes Grids below)
Assessment 1 - Individual coursework task (20%)
Assessment 2 - Adapted Assessment (Online open book) (80%)
(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**
Unseen open book (standard)	✓	✓	✓	✓		80	2

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
Coursework	✓					20	