Module Descriptor

Title	Multivariable Calculus		
Session	2025/26	**Status**	Published
Code	MATH08008	**SCQF Level**	8
Credit Points	20	**ECTS (European Credit Transfer Scheme)**	10
School	**Computing, Engineering and Physical Sciences**		
Module Co-ordinator	Dr Kenneth Nisbet		

Summary of Module

This module extends the ideas in basic differentiation and integration of functions of one variable to the calculus of more than one variable.

The idea of partial differentiation will be introduced, both at first and higher order, as well as the more general idea of a directional derivative. These concepts will be used in various settings, including the location and classification of critical points in routine contexts and applications in optimisation problems, e.g. using Lagrange multipliers.

Vector calculus will be explored, including a treatment of such notions as the gradient of a scalar field, and the divergence and curl of a vector field, both in routine and applied settings.

The concept of basic integration will be extended to a range of problems involving double and triple integrals, e.g. repeated integrals, change of order, use of substitution, such as the use of polar coordinates. Line integrals, including their application to problems involving conservative vector fields, and surface integrals of both scalar and vector fields will be discussed.

Suitable software will be used to solve more elaborate problems in these topics.

The Graduate Attributes relevant to this module are given below:

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

Module Delivery Method	On-Campus[1] ☒	Hybrid[2] ☐	Online[3] ☐	Work -Based Learning[4] ☐
Campuses for Module Delivery	☐ Ayr ☐ Dumfries	☐ Lanarkshire ☐ London ☒ Paisley	☐ Online / Distance Learning ☐ Other (specify)	

Terms for Module Delivery	Term 1	☒	Term 2	☐	Term 3	☐
Long-thin Delivery over more than one Term	Term 1 – Term 2	☐	Term 2 – Term 3	☐	Term 3 – Term 1	☐

Learning Outcomes	
L1	Apply analytically a range of techniques in partial differentiation.
L2	Solve multiple and line integration problems analytically using standard techniques.
L3	Implement a range of analytic techniques in vector calculus.
L4	Apply, and interpret the output from mathematical software in a range of multivariable calculus problem.
L5	

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 8** Demonstrating a knowledge and understanding of important techniques in the calculus of more than one variable. Demonstrating critical awareness of established techniques of enquiry in common applications of multivariable calculus
Practice: Applied Knowledge and Understanding	**SCQF 8** Using a range of standard techniques to solve problems at an advanced level, sometimes in non-routine contexts.

[1] Where contact hours are synchronous/ live and take place fully on campus. Campus-based learning is focused on providing an interactive learning experience supported by a range of digitally-enabled asynchronous learning opportunities including learning materials, resources, and opportunities provided via the virtual learning environment. On-campus contact hours will be clearly articulated to students.

[2] The module includes a combination of synchronous/ live on-campus and online learning events. These will be supported by a range of digitally-enabled asynchronous learning opportunities including learning materials, resources, and opportunities provided via the virtual learning environment. On-campus and online contact hours will be clearly articulated to students.

[3] Where all learning is solely delivered by web-based or internet-based technologies and the participants can engage in all learning activities through these means. All required contact hours will be clearly articulated to students.

[4] Learning activities where the main location for the learning experience is in the workplace. All required contact hours, whether online or on campus, will be clearly articulated to students

	Conducting defined investigative problems within a mathematically based subject
Generic Cognitive skills	**SCQF 8** Conceptualising and analysing problems informed by professional and research issues.
Communication, ICT and Numeracy Skills	**Please select SCQF Level** Making formal written presentation(s) based on the output from investigative problems, including the use of mathematical software.
Autonomy, Accountability and Working with Others	**Please select SCQF Level** Exercising independence and initiative in conducting a range of activities. Identifying learning needs through reflection based on self, tutor, and peer evaluation of work.

Prerequisites	**Module Code**	**Module Title**
	MATH07009	Single Variable Calculus
	Other or equivalent	
Co-requisites	**Module Code**	**Module Title**

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** (Note: Learning hours include both contact hours and hours spent on other learning activities)
Lecture / Core Content Delivery	24
Tutorial / Synchronous Support Activity	12
Laboratory / Practical Demonstration / Workshop	12
Independent Study	152
Please select	
Please select	
TOTAL	200

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

"Multivariable Calculus" class notes as published on the University VLE. Bespoke mathematical software. "Calculus II", TM Apostol. "Calculus: One and Several Variables", SL Salas, GJ Etgen and E Hille
(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. **For the purposes of this module, academic engagement equates to the following:** The School of Computing, Engineering and Physical Sciences considers attendance and engagement to mean a commitment to attending, and engaging in, timetabled sessions. You will scan your attendance via the scanners each time you are on-campus and you will login to the VLE several times per week. Where you are unable to attend a timetabled learning session due to illness or other circumstance, you should notify the Programme Leader that you cannot attend. Across the School an 80% attendance threshold is set. If you fall below this, you will be referred to the Student Success Team to see how we can best support your studies.

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. Aligned with the University's commitment to equality and diversity, this module supports equality of opportunity for students from all backgrounds and learning needs. Using the VLE, material will be presented electronically in formats that allow flexible access and manipulation of content. This module complies with University regulations and guidance on inclusive learning and teaching practice. This module has computer lab-based teaching and as such you are advised to speak to the Module Co-ordinator to ensure that specialist assistive equipment, support provision and adjustment to assessment practice can be put in place, in accordance with the University's policies and regulations.
(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 Physical Sciences**
Overall Assessment Results	☐ **Pass / Fail** ☒ **Graded**
Module Eligible for Compensation	☒ **Yes** ☐ **No** **If this module is eligible for compensation, there may be cases where compensation is not permitted due to programme accreditation requirements. Please check the associated programme specification for details.**
School Assessment Board	Physical Sciences
Moderator	Dr Wan Mekwi

External Examiner	Dr Chris Guiver
Accreditation Details	
Module Appears in CPD catalogue	☐ **Yes** ☒ **No**
Changes / Version Number	1.09. Hours amended. Learning Outcome 4 added and Skills updated. Assessment boxes updated. Prerequisite tidied up.

Assessment (also refer to Assessment Outcomes Grids below)
Assessment 1
A series of individual coursework assignments, comprising a mixture of hand calculations and computer based exercises.
Assessment 2
Class Test (Unseen, closed book)
Assessment 3
(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.)

Component 1							
Assessment Type	**LO1**	**LO2**	**LO3**	**LO4**	**LO5**	**Weighting of Assessment Element (%)**	**Timetabled Contact Hours**
Class Test (unseen, closed book)	☒	☒	☒	☐	☐	50	2

Component 2							
Assessment Type	**LO1**	**LO2**	**LO3**	**LO4**	**LO5**	**Weighting of Assessment Element (%)**	**Timetabled Contact Hours**
Coursework Assignment	☒	☒	☒	☒	☐	50	0

Component 3							
Assessment Type	**LO1**	**LO2**	**LO3**	**LO4**	**LO5**	**Weighting of Assessment Element (%)**	**Timetabled Contact Hours**
	☐	☐	☐	☐	☐		
Combined total for all components						100%	hours

Change Control

What	**When**	**Who**

Learning Outcome 4 added and Skills updated. Assessment boxes updated.	March 2025	Kenneth Nisbet
Prerequisite tidied up.	March 2025	Kenneth Nisbet
Hours amended	March 2025	Kenneth Nisbet