MODULE TITLE	**Calculus and Geometry**	**CREDIT VALUE**	**15**
MODULE CODE	**ECM1901**	**MODULE CONVENER**	**Dr Mark Callaway (Coordinator)**

DURATION: TERM	**1**	**2**	**3**
DURATION: WEEKS	**11**	**0**	**0**

Number of Students Taking Module (anticipated)	**40**

DESCRIPTION - summary of the module content

Calculus has its origins in the study of planetary motion. Calculus is fundamental to mathematics and provides tools for analysing a diverse range of problems across the physical, engineering, life and environmental sciences. You will develop your ability to think logically, to analyse complex relationships, and to recognize underlying simple ideas and structures common to almost all problems in mathematics – these are the skills required to do mathematics. You will renew your knowledge about tools and concepts, which you have already been in contact with in school in a more rigorous way, and study further links to more complex fundamental ideas, which will enable you to quickly and accurately perform calculus on functions using a variety of standard techniques.

The module gives an informal treatment of theorems from analysis. You will learn how to accurately sketch the graphs of functions. It will also teach you how to reason using abstract ideas, formulate and solve problems and communicate reasoning and solutions effectively in writing and oral presentation. As with the other modules, it will develop your self-management and time-management skills and broaden your use of learning resources including the use of IT.

You will work on weekly exercise sheets; you will be asked to form study groups with fellow students to solve these problems.
For the assessed coursework you will be asked to submit questions from previous exercise sheets or answer similar questions – this will take place in class on a fortnightly basis. This should encourage you to work out solutions for all problems from the weekly exercise sheets (this can happen in small groups, but the in class assessment must be carried out individually).

AIMS - intentions of the module

The aim is to develop knowledge and skills in calculus and introduce some formal definitions and statements of theorems from analysis, but with only limited formal proofs. The module is about developing methods and skills for calculus-related manipulation of the mathematical objects that form the basis of much of an undergraduate course in mathematics, and subsequent applications in science and engineering.

INTENDED LEARNING OUTCOMES (ILOs) (see assessment section below for how ILOs will be assessed)

On successful completion of this module ***you should be able to***:

Module Specific Skills and Knowledge
1 demonstrate an understanding of basic concepts concerning sequences, series, functions and limits;
2 perform accurate calculus manipulations using a variety of standard techniques; sketch the graphs of a variety of functions of one variable; determine and categorise extrema;

Discipline Specific Skills and Knowledge
3 demonstrate a basic knowledge and understanding of fundamental concepts of functions, sequences, series, limits and differential calculus necessary for progression to successful further studies in the mathematical sciences;
4 understand how to read mathematical definitions, theorems and proofs; understand the logic behind different methods of proof, the mechanics of using them and gain experience in applying them; develop an appreciation of the role of rigorous proof in mathematics.

Personal and Key Transferable / Employment Skills and Knowledge
5 reason using abstract ideas, formulate and solve problems and communicate reasoning and solutions effectively in writing and oral presentation;

6 work in groups to solve in-depth problems effectively; and learn to analyse/assess other solutions for problems;

7 acquire ability for self-criticism of your work;

8 demonstrate appropriate use of learning resources;

9 demonstrate self management and time management skills.

SYLLABUS PLAN - summary of the structure and academic content of the module

- “Calculus and Geometry” and “Vectors and matrices” fundamentals (see also ECM1902): Introduction to sets, number systems, logic and proof;inequalities and intervals [4 hours (+4 hours in “Vectors and Matrices”)];
- Functions: dependent and independent variables; injections, surjections and bijections, image and preimage. Real functions: graphs, even and odd functions, sums, differences, products, quotients, composition; inverse functions; trigonometric and hyperbolic functions [4 hours];
- Analytic geometry: Cartesian coordinates, parametric equations, conic sections, normals and tangents [4 hours];
- Sequences: finite and infinite sequences; geometric and arithmetic progressions; convergence, limits of sequences, algebra of limits [4 hours];
- Series: partial sums and series; algebraic operations on series; absolute convergence, convergence tests; power series [4 hours];
- Mid-term “Calculus and Geometry” and “Vectors and matrices” revision and mastery (see also ECM1902): focus on rigorous analysis, mathematical proofs and in-depth problems [4 hours (+4 hours in “Vectors and Matrices”)];

- Continuity of functions: definition of a limit, sequential definition, one-sided limits; continuity; connectivity and the Intermediate Value Theorem [4 hours];

- Differentiation in one variable: definition of the derivative; rules for differentiation; differentiation techniques; higher order derivatives, Leibniz's rule [4 hours];

- Applications of differentiation: maxima and minima of functions; Mean Value Theorems; L'Hopital's rule [4 hours];
- Taylor polynomials and series [4 hours];
- Revision and mastery [4 hours].

LEARNING AND TEACHING

LEARNING ACTIVITIES AND TEACHING METHODS (given in hours of study time)

Scheduled Learning & Teaching Activities	44.00	**Guided Independent Study**	106.00	**Placement / Study Abroad**	0.00

DETAILS OF LEARNING ACTIVITIES AND TEACHING METHODS

Category	Hours of study time	Description
Scheduled Learning & Teaching activities	11	Formal lectures of new material
Scheduled Learning & Teaching activities	33	Seminars and tutorials, worked examples, with individual and group support
Guided Independent Study	106	Lecture & assessment preparation, wider reading

ASSESSMENT

FORMATIVE ASSESSMENT - for feedback and development purposes; does not count towards module grade

Form of Assessment	Size of Assessment (e.g. duration/length)	ILOs Assessed	Feedback Method
Weekly exercises	10 x 1 hours	1-9	Exercises discussed in class, solutions provided.
Mid-term revision and mastery exercises	6 hours	1-9	Exercises discussed in class, solutions provided.

SUMMATIVE ASSESSMENT (% of credit)

Coursework	20	Written Exams	80	Practical Exams	0

DETAILS OF SUMMATIVE ASSESSMENT

Form of Assessment	% of Credit	Size of Assessment (e.g. duration/length)	ILOs Assessed	Feedback Method
In-class tests based on formative question sheets	20	On a fortnightly basis students will be set a small number of questions from the previous 2 weeks' formative exercise sheets or similar questions based on these, to be attempted in class in a set time (approx. 30mins). Students will therefore be encouraged to complete all formative questions before hand. This in-class assessment will simply endorse this prior work, but students will be able to attempt these questions from scratch.	1-9	Annotated scripts with feedback from peers, tutor and/or module leader. Oral feedback from module leader. Solutions provided.
Written exam - Closed book	80	2 hours	1-4, 6-8	Written/verbal on request

DETAILS OF RE-ASSESSMENT (where required by referral or deferral)

Original Form of Assessment	Form of Re-assessment	ILOs Re-assessed	Time Scale for Re-assessment
All above	Written Exam (100%)	All	August Ref/Def Period

RE-ASSESSMENT NOTES

If a module is normally assessed entirely by coursework, all referred/deferred assessments will normally be by assignment. If a module is normally assessed by examination or examination plus coursework, referred and deferred assessment will normally be by examination. For referrals, only the examination will count, a mark of 40% being awarded if the examination is passed. For deferrals, candidates will be awarded the higher of the deferred examination mark or the deferred examination mark combined with the original coursework mark.

RESOURCES

INDICATIVE LEARNING RESOURCES - The following list is offered as an indication of the type & level of information that you are expected to consult. Further guidance will be provided by the Module Convener

Basic reading:
ELE: http://vle.exeter.ac.uk

Other Resources:

Reading list for this module:

Type	Author	Title	Edition	Publisher	Year	ISBN	Search
Set	Stewart J.	Calculus	5th	Brooks/Cole	2003	000-0-534-27408-0	[Library]
Set	Finney R.L., Maurice D., Weir M and Giordano F.R.	Thomas' calculus based on the original work by George B. Thomas, Jr.	10th or later	Addison-Wesley	2003	000-0-321-11636-4	[Library]
Set	McGregor C., Nimmo J. & Stothers W.	Fundamentals of University Mathematics	2nd	Horwood, Chichester	2000	000-1-898-56310-1	[Library]
Set	Tan, Soo T	Calculus	International edition	Brooks/Cole Cengage Learning	2010	978-0495832294	[Library]
Set	Tan, T Soo	Calculus Early Transcendentals	International edition	Brooks Cole/Cengage learning	2010	978-1439045992	[Library]
Set	Chandler, F S, Bostcok, L	Core maths for advanced level	3rd revised	Nelson Thornes	2000	978-0748755097	[Library]

CREDIT VALUE	15	ECTS VALUE	7.5
PRE-REQUISITE MODULES	None		
CO-REQUISITE MODULES	None		
NQF LEVEL (FHEQ)	4	AVAILABLE AS DISTANCE LEARNING	No
ORIGIN DATE	Thursday 06 July 2017	LAST REVISION DATE	Friday 30 November 2018
KEY WORDS SEARCH	Functions; Graphs; Sequences; Series; Limits; Differentiation; Maxima and minima; Taylor series.		