1. **Title of the module**

MAST4010 (MA352) - Real Analysis 1

1. **School or partner institution which will be responsible for management of the module**

School of Mathematics, Statistics and Actuarial Science

1. **The level of the module (Level 4, Level 5, Level 6 or Level 7)**

Level 4

1. **The number of credits and the ECTS value which the module represents**

15 credits (7.5 ECTS)

1. **Which term(s) the module is to be taught in (or other teaching pattern)**

Autumn

1. **Prerequisite and co-requisite modules**

Co-requisite: MAST4006: Mathematical Methods 1

1. **The programmes of study to which the module contributes**

BSc Mathematics, BSc Mathematics and Statistics, BSc Financial Mathematics (including programmes with a Year in Industry), BSc Mathematics with Secondary Education, BSc Mathematics with a Foundation Year, MMath Mathematics, MMathStat Mathematics and Statistics

1. **The intended subject specific learning outcomes.
On successfully completing the module students will be able to:**

8.1 demonstrate knowledge of the underlying concepts and principles associated with continuity and differentiability of real functions;

8.2 demonstrate the capability to make sound judgements in accordance with the basic theories and concepts in the following areas, whilst demonstrating a reasonable level of skill in calculation and manipulation of the material: real numbers, limits of sequences, completeness properties, continuity of functions, differentiation, Taylor approximation;

8.3 apply the underlying concepts and principles associated with continuity and differentiablility in several well-defined contexts, showing an ability to evaluate the appropriateness of different approaches to solving problems in this area.

1. **The intended generic learning outcomes.
On successfully completing the module students will be able to:**

Demonstrate an increased ability to:

9.1 manage their own learning and make use of appropriate resources;

9.2 understand logical arguments, identifying the assumptions made and the conclusions drawn;

9.3 communicate straightforward arguments and conclusions reasonably accurately and clearly;

9.4 manage their time and use their organisational skills to plan and implement efficient and effective modes of working;

9.5 solve problems relating to qualitative and quantitative information;

9.6 make use of information technology skills such as online resources (moodle), internet communication;

9.7 communicate technical material competently.

9.8 demonstrate an increased level of skill in numeracy and computation.

1. **A synopsis of the curriculum**

Real Numbers: Rational and real numbers, absolute value and metric structure on the real numbers, induction, infimum and supremum.

Limits of Sequences: Sequences, definition of convergence, epsilon terminology, uniqueness, algebra of limits, comparison principles, standard limits, subsequences and non-existence of limits, convergence to infinity.

Completeness Properties: Cantor's Intersection Theorem, limit points, Bolzano-Weierstrass theorem, Cauchy sequences.

Continuity of Functions: Functions and basic definitions, limits of functions, continuity and epsilon terminology, sequential continuity, Intermediate Value Theorem.

Differentiation: Definition of the derivative, product rule, quotient rule and chain rule, derivatives and local properties, Mean Value Theorem, L'Hospital's Rule.

Taylor Approximation: Taylor's Theorem, remainder term, Taylor series, standard examples, limits using Taylor series.

1. **Reading list (Indicative list, current at time of publication. Reading lists will be published annually)**

There is no essential reading or core text. Recommended background reading includes:

D. Brannan: A first course in mathematical analysis. 2006.

F. Hart: Guide to analysis. 2001.

A. Mattuck: Introduction to analysis. 2013.

Additional reading includes:

L. Alcock: How to think about analysis. 2014.

1. **Learning and teaching methods**

Total contact hours: 48

Private study hours: 102

Total study hours: 150

1. **Assessment methods**
	1. Main assessment methods

Assessment 1 Exercises, requiring on average between 10 and 15 hours to complete 10%

Assessment 2 Exercises, requiring on average between 10 and 15 hours to complete 10%

Examination 2 hours 80%

The coursework mark alone will not be sufficient to demonstrate the student’s level of achievement on the module.

13.2 Reassessment methods

Like-for-like

1. **Map of module learning outcomes (sections 8 & 9) to learning and teaching methods (section12) and methods of assessment (section 13)**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Module learning outcome** | 8.1 | 8.2 | 8.3 | 9.1 | 9.2 | 9.3 | 9.4 | 9.5 | 9.6 | 9.7 | 9.8 |
| **Learning/ teaching method** |  |  |  |  |  |  |  |  |  |  |  |
| Private Study and Assessment | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** |
| Lectures/Exercise classes | **X** | **X** | **X** |  | **X** | **X** |  | **X** |  | **X** | **X** |
| Tutorials | **X** | **X** | **X** |  | **X** | **X** |  | **X** |  | **X** | **X** |
| Revision classes | **X** | **X** | **X** |  | **X** | **X** |  | **X** |  | **X** | **X** |
| **Assessment method** |  |  |  |  |  |  |  |  |  |  |  |
| Examination | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** |  | **X** | **X** |
| Coursework | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** |

1. **Inclusive module design**

The School recognises and has embedded the expectations of current equality legislation, by ensuring that the module is as accessible as possible by design. Additional alternative arrangements for students with Inclusive Learning Plans (ILPs)/declared disabilities will be made on an individual basis, in consultation with the relevant policies and support services.

The inclusive practices in the guidance (see Annex B Appendix A) have been considered in order to support all students in the following areas:

a) Accessible resources and curriculum

b) Learning, teaching and assessment methods

1. **Campus(es) or centre(s) where module will be delivered**

Canterbury

1. **Internationalisation**

Mathematics is an international language with techniques developed and refined by mathematicians across the globe. Mastery of the subject-specific learning outcomes, 8.1 to 8.3, will equip students to apply the theories and techniques of this module in a wide range of international contexts. The module team is drawn from the School of Mathematics, Statistics and Actuarial Science, which includes many members of staff with international experience of teaching and research collaboration.

In compiling the reading list, consideration has been given to the range of texts that are available internationally and a selection of texts has been identified to complement the delivery of the material.

The support SMSAS provides to its students is also internationally attuned given our international student body.

**FACULTIES SUPPORT OFFICE USE ONLY**

**Revision record – all revisions must be recorded in the grid and full details of the change retained in the appropriate committee records.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Date approved | Major/minor revision | Start date of the delivery of revised version | Section revised | Impacts PLOs (Q6&7 cover sheet) |
|  |  |  |  |  |
|  |  |  |  |  |

Revised FSO Jan 2018