1. **Title of the module**

MAST5870 (MA587) - Numerical solution of differential equations

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 6

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**

Pre-requisite: MAST5005 (Linear Partial Differential Equations), MAST5012 (Ordinary Differential Equations)

Co-requisite: None

Recommended: MAST5009 (Numerical Methods)

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

BSc Mathematics, BSc Financial Mathematics (including programme with a Year in Industry), BSc Mathematics with a Foundation Year, MMath Mathematics, Graduate Diploma in Mathematics, International MSc in Mathematics and its Applications, MSc in Mathematics and its Applications (including programme with an Industrial Placement)

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

8.1 demonstrate systematic understanding of key aspects of finite difference methods for approximating solutions of ordinary differential equations (ODEs) and partial differential equations (PDEs);

8.2 demonstrate the capability to deploy established approaches accurately to analyse and solve problems using a reasonable level of skill in calculation and manipulation of the material in the following areas: multistep methods, approximation of boundary value problems for ODEs, discretization of PDEs, error and stability analysis, elementary numerical linear algebra;

8.3 apply key aspects of finite difference methods in well-defined contexts, showing judgement in the selection and application of tools and techniques;

8.4 show judgement in the selection and application of Matlab commands to implement numerical methods.

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

9.9 demonstrate the acquisition of the study skills needed for continuing professional development.

1. **A synopsis of the curriculum**

Most differential equations which arise from physical systems cannot be solved explicitly in closed form, and thus numerical solutions are an invaluable way to obtain information about the underlying physical system. The first half of the module is concerned with ordinary differential equations. Several different numerical methods are introduced and error growth is studied. Both initial value and boundary value problems are investigated. The second half of the module deals with the numerical solution of partial differential equations. The syllabus includes: initial value problems for ordinary differential equations; Taylor methods; Runge-Kutta methods; multistep methods; error bounds and stability; boundary value problems for ordinary differential equations; finite difference schemes; difference schemes for partial differential equations; iterative methods; stability analysis.

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

Burden, R.L., and Faires, J.D., and Burden, A. M., Numerical Analysis, 10th edition, Cengage Learning, 2016

Iserles, A first course in the numerical analysis of differential equations, 2nd edition, Cambridge University Press, 2009

Morton, K. W. and Mayers, D.F., Numerical solution of partial differential equations: an introduction, Cambridge University Press, 2011

1. **Learning and teaching methods**

Total contact hours: 42

Private study hours: 108

Total study hours: 150

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

Assessment 1 Exercises, requiring on average between 10 and 15 hours to complete 20%

Assessment 2 Exercises, requiring on average between 10 and 15 hours to complete 20%

Examination 2 hours 60%

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 | 8.4 | 9.1 | 9.2 | 9.3 | 9.4 | 9.5 | 9.6 | 9.7 | 9.8 | 9.9 |
| **Learning/ teaching method** |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Private Study and Assessment | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** | **X** |
| Lectures/Exercise classes | **X** | **X** | **X** |  |  | **X** | **X** |  | **X** |  | **X** | **X** |  |
| Terminal sessions |  |  |  | **X** |  |  |  |  |  |  |  |  |  |
| Revision classes | **X** | **X** | **X** |  |  | **X** | **X** |  | **X** |  | **X** | **X** |  |
| **Assessment method** |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Examination | **X** | **X** | **X** |  | **X** | **X** | **X** | **X** | **X** |  | **X** | **X** | **X** |
| Coursework | **X** | **X** | **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 8.4, 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.

Examples with an international dimension are included in the module where appropriate.

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) |
| 11/04/2022 | Minor | September 2022 | 6 | No |
| July 2023 | Minor | September 2023 | 6, 13 | No |