MSc/PG Diploma in the Numerical Solution of Differential Equations
For students entering in 2005

Awarding Institution:	The University of Reading
Teaching Institution:	The University of Reading
Faculty of Science	Programme length: 12 months
Date of specification: April 2005	
Programme Director:	Dr P.K. Sweby
Board of Studies:	NSDE MSc
Accreditation:	

Summary of programme aims

Both the MSc and PG Diploma courses aim to

- introduce students to a range of topics and technical skills in the chosen area, leading to a variety of potential applications and career opportunities;
- inculcate an insight into current practice in the chosen area, particularly techniques relevant to professional practice;
- enhance students' communication skills;
- provide an appreciation of the link between theory and application in the chosen area of study.

Transferable skills

The courses will provide a range of transferable skills, including generic training in IT (operating systems, programming, computer graphics and word-processing) and in Communication and Research Skills (including good practice and experience in written and oral presentations and in literature searches).

Programme content

MSc

Autumn and Spring Terms: In addition to the modules listed as core, students must choose a total of TWO modules from the list of options.

Remainder of course: There is the literature seminar (which forms part of the Communication and Research Skill module MAMB5) plus one core module (MAMC1) in the Summer Term and students must complete a dissertation (worth 60 credits) by the end of August.

PG Diploma

There are two possible routes to the PG Diploma

EITHER:

Autumn and Spring Terms: In addition to the modules listed as core, students must choose a total of TWO modules from the list of options (each worth 10 credits).

Summer Term: There is the literature seminar (which forms part of the Communication and Research Skill module MAMB5) plus one core module (MAMC1).

OR:

Autumn and Spring Terms: Students only take the core modules.

Summer Term: There is the literature seminar (which forms part of the Communication and Research Skills module MAMB5) plus one core module (MAMC1). In addition students complete an extended essay (worth 20 credits) by the end of June.

MSc and Diploma

There are also some non-assessed elements in the course. These include introductory material and attendance at the weekly seminar series.

Mod Code	***Module Title***	***Credits***	***Level***
Autumn Term (introductory modules)			
MAMI1	Elementary Numerical Analysis		M
MAMI2	Basic Functional Analysis		M
Autumn Term (core modules)			
MAMA2	Numerical Solution of Initial Value Problems	15‡	M
MAMA3	Theory of Differential Equations	10	M
MAMA4	Dynamical Systems and Fluid Dynamics	10	M
MAMA5†	Computing Techniques and Projects	20	M
Autumn Term (optional modules)			
MAMA8 †	Reaction-Diffusion Theory	20	M
MAMA10†	Reading Course	10	M
MAMB9	Asymptotic Methods	10	M
MTMG02	Atmospheric Physics	10	M
Spring Term (core modules)			
MAMB2	Numerical Solution of Boundary Value Problems	15‡	M
MAMB3	Finite Element Methods	10	M
MAMB4	Numerical Techniques for Conservation Laws	10	M
MAMB5 †	Communication and Research Skills	10	M
Spring Term (core non-assessed module)			
MAMB6	Industrial Modelling		M
Spring Term (optional modules)			
MAMB8	Integral Equations	10	M
MAMB10	Theory and Techniques of Data Assimilation	10	M
MTMW14	Numerical Modelling of the Atmosphere and Oceans	10	M
Summer Term (core non-assessed module)			
MAMC1	Advanced Numerical Solution of Differential Equations		M
Summer Term (dissertation/extended essay)			
MAMC2	Dissertation	60	M
MAMC3	Extended Essay	20	M

† denotes a module which continues into the following term
‡ neither MAMA2 or MAMB2 can be taken in isolation

Part-time/Modular arrangements

The programme may be taken over two years on a part-time basis. The minimum requirements are the equivalent of two days a week in the first term with the equivalent of 1 day a week for the five subsequent terms. The project will require the equivalent of 30 days and access to suitable facilities to carry out the work.

Progression requirements

For the MSc course progression to the project, and for the PG Diploma progression to the essay, requires an overall average of 50% in the modules taken to date with not less than 40% in any module. Marks below 40% in a total of 30 credits will be condoned provided that the candidate has pursued the course for the module(s) with reasonable diligence and has attempted the examination. A mark of at least 40% must be obtained in MAMA5.

Summary of teaching and assessment

The programme consists of two terms taught courses, with an additional non-assessed course and the literature seminar in the first four weeks of the third term. Teaching is by lectures, supplemented by guided reading and, where appropriate, practical computations. With the exception of the Computing Techniques and Project module (MAMA5) and the Communication Skills module (MAMB5) assessment is by open note examination in the vacation following the term in which the module is delivered. All assessed modules contribute to the final mark.

The University's taught postgraduate marks classification is as follows:

Mark	Interpretation
70 – 100%	Distinction
60 – 69%	Merit
50 – 59%	Good standard (Pass)
Failing categories:	
40 – 49%	Work below threshold standard
0 – 39%	Unsatisfactory Work

For Masters Degrees
To pass the MSc students must gain an average mark of 50 or more overall including a mark of 50 or more for the dissertation and a mark of 40 or more in MAMA5. In addition the total credit value of all modules marked below 40 must not exceed 30 credits and for all modules marked below 50 must be less than 60 credits.*

Students who gain an average mark of 70 or more overall including a mark of 60 or more for the dissertation and have no mark below 40 will be eligible for a Distinction. Those gaining an average mark of 60 or more overall including a mark of 50 or more for the dissertation and have no mark below 40 will be awarded eligible for a Merit.

* The provision to permit a candidate to be passed overall with a profile containing marks below 40 is made subject to the condition that there is evidence that the candidate applied his or herself to the work of those modules with reasonable diligence and has not been absent from the examination without reasonable cause.

For PG Diplomas
To pass the Postgraduate Diploma students must gain an average mark of 50 or more and a mark of 40 or more in MAMA5. In addition the total credit value of all modules marked below 40 must not exceed 30 credits and for all modules marked below 50 must be less than 60 credits.*

Students who gain an average mark of 70 or more and have no mark below 40 will be eligible for the award of a Distinction. Those gaining an average mark of 60 or more and have no mark below 40 will be awarded eligible for a Merit.

Admission requirements
Entrants to this programme are normally required to have obtained an upper second in a three-year Mathematics programme or a joint programme with a substantial mathematical content, although a good lower second may be sufficient.

Admissions Tutor: Dr P.K. Sweby

Support for students and their learning
University support for students and their learning falls into two categories. Learning support includes IT Services, which has several hundred computers and the University Library, which across its three sites holds over a million volumes, subscribes to around 4,000 current periodicals, has a range of electronic sources of information and houses the Student Access to Independent Learning (S@IL) computer-based teaching and learning facilities. There are language laboratory facilities both for those students studying on a language degree and for those taking modules offered by the Institution-wide Language Programme. Student guidance and welfare support is provided by Programme Directors, the Careers Advisory Service, the University's Special Needs Advisor, Study Advisors, Hall Wardens and the Students' Union.

Career prospects
The courses will provide the basic mathematical tools required for the development and analysis of modern numerical techniques for the solution of differential equations and will provide experience in implementing and applying the numerical procedures to industrial models. Graduates will therefore possess the skills required for development and effective use of specialist, application based, computer packages. The courses will enable mathematicians, scientists and engineers with a wide variety of backgrounds and specific subject interests to obtain the mathematical foundations and practical skills needed for computational modelling in modern industry.

Opportunities for study abroad or for placements
None

Educational aims of the programme
The Numerical Solution of Differential Equations course covers a wide variety of mathematical topics and technical skills, with a variety of potential applications and career opportunities. The general aim of the programme is to convert new graduates from first degree courses containing a significant amount of Mathematics into postgraduates possessing a deeper insight into numerical analysis and modelling of direct use to Industry. The course gives a secure foundation in the subject which is invaluable for the effective and intelligent use of numerical techniques.

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* The provision to permit a candidate to be passed overall with a profile containing marks below 40 is made subject to the condition that there is evidence that the candidate applied his or herself to the work of those modules with reasonable diligence and has not been absent from the examination without reasonable cause.

Another important aim is to give students practical competence in the numerical solution of various types of differential equations. This is essential if the objective is to enter industry at the end of the Course, but it is equally important for anyone aiming for a higher degree in even the most theoretical aspects of the subject.

Programme Outcomes: MSc

Knowledge and Understanding

A. Knowledge and understanding of:	**Teaching/learning methods and strategies**
1. basic theory of differential equations, including well-posedness. Illustrative physical scenarios which the equations may model; 2. Classical finite difference schemes for numerical solution of initial and boundary value problems; 3. dynamics of numerics; 4. finite element and finite volume methods for numerical solution of differential equations; 5. acceleration techniques and solvers; 6. aspects of computational grids and their generation; 7. modern adaptive numerical methods for the solution of conservation laws; 8. types of problems encountered in industry and techniques for their solution; 9. the FORTRAN 90 programming language.	The knowledge is delineated through formal lectures supported by guided reading and problem sheets. Model solutions are provided and feedback given. Feedback on the programming is given initially via non-assessed programming exercises, and later assessed projects. The industrial expertise is delivered in a series of lectures by outside industrial speakers. (MAMB6). *Assessment* Understanding is tested through open note examinations and course work.

Skills and other attributes

B. Intellectual skills – able to:

1. apply knowledge and understanding gained to a variety of familiar and unfamiliar situations;
2. critically analyse numerical results;
3. show independence and initiative in approaches to problem solving;
4. present material clearly to expert and non-expert audiences in written and oral forms;
5. critically review, synthesise and evaluate published research;
6. conduct independent study of a chosen topic and report on the results.

Teaching/learning methods and strategies

1,2 and 3 are developed by a combination of problem sheets, worked examples, coursework assignments, computing project work and dissertation.
4 and 5 are addressed by lectures, practice presentations and the literature seminar in the Communication and Research Skills module, and also by the dissertation.
6 is covered by the dissertation.

Assessment

1, 2 and 3 (in part) are assessed by coursework and examination. 4 and 5 are mainly assessed through the literature seminar and dissertation. 3 and 6 are assessed by the dissertation.

C. Practical skills – able to:

1. program a computer in a structured and effective way;
2. analyse numerical methods and respond to the issues of accuracy, stability and convergence;
3. plan, conduct and report on investigations;
4. reference work in an appropriate manner.

Teaching/learning methods and strategies

1 is achieved via the Computing Techniques and Projects module. Most modules enhance skill 2. 3 and 4 are addressed through guidance on the project/ dissertation work.

Assessment

1 and 2 are tested by computing projects and examinations. 3 and 4 are assessed by the project /dissertation.

D. Transferable skills – able to:

1. communication: the ability to communicate knowledge effectively through written and oral presentations;
2. computation and IT: use of the computer to solve numerical problems and to analyse and present results using standard and mathematical software;
3. self management and professional development: study skills, independent learning, time management;
4. library skills: effective use of library resources.

Teaching/learning methods and strategies

Skills 1 and 2 are developed throughout most of the programme, but especially in the Computing Techniques and Projects and Communication and Research Skills modules. 3 is encourage throughout the programme. 4 is covered by the Communication and Research Skills module and the dissertation.

Assessment

1 and 2 are assessed through coursework, examinations, literature seminar and dissertation. 3 is indirectly assessed throughout the programme by its influence on performance. 4 is indirectly assessed in the dissertation.

Please note: This specification provides a concise summary of the main features of the programme and the learning outcomes that a typical student might reasonably expect to achieve and demonstrate if he/she takes full advantage of the learning opportunities that are provided. More detailed information on the learning outcomes, content and teaching, learning and assessment methods of each module can be found in module and programme handbooks.

Programme Outcomes: Diploma

Knowledge and Understanding

A. Knowledge and understanding of:	**Teaching/learning methods and strategies**
1. basic theory of differential equations, including well-posedness. Illustrative physical scenarios which the equations may model; 2. Classical finite difference schemes for numerical solution of initial and boundary value problems; 3. dynamics of numerics; 4. finite element and finite volume methods for numerical solution of differential equations; 5. acceleration techniques and solvers; 6. aspects of computational grids and their generation; 7. modern adaptive numerical methods for the solution of conservation laws; 8. types of problems encountered in industry and techniques for their solution; 9. the FORTRAN 90 programming language.	The knowledge is delineated through formal lectures supported by guided reading and problem sheets. Model solutions are provided and feedback given. Feedback on the programming is given initially via non-assessed programming exercises, and later assessed projects. The industrial expertise is delivered in a series of lectures by outside industrial speakers. (MAMB6). *Assessment* Understanding is tested through open note examinations and course work.

Skills and other attributes

B. Intellectual skills – able to:	**Teaching/learning methods and strategies**
1. apply knowledge and understanding gained to a variety of familiar and unfamiliar situations; 2. critically analyse numerical results; 3. show independence and initiative in approaches to problem solving; 4. present material clearly to expert and non-expert audiences in written and oral forms; 5. critically review, synthesise and evaluate published research;	1,2 and 3 are developed by a combination of problem sheets, worked examples, coursework assignments, computing project work and dissertation. 4 and 5 are addressed by lectures, practice presentations and the literature seminar in the Communication and Research Skills module. *Assessment* 1, 2 and 3 are assessed by coursework and examination. 4 and 5 are mainly assessed through the literature seminar.

C. Practical skills – able to:

1. program a computer in a structured and effective way;
2. analyse numerical methods and respond to the issues of accuracy, stability and convergence;

Teaching/learning methods and strategies

1 is achieved via the Computing Techniques and Projects module. Most modules enhance skill 2.

Assessment

1 and 2 are tested by computing projects and examinations.

D. Transferable skills – able to:

1. communication: the ability to communicate knowledge effectively through written and oral presentations;
2. computation and IT: use of the computer to solve numerical problems and to analyse and present results using standard and mathematical software;
3. self management and professional development: study skills, independent learning, time management;
4. library skills: effective use of library resources.

Teaching/learning methods and strategies

Skills 1 and 2 are developed throughout most of the programme, but especially in the Computing Techniques and Projects and Communication and Research Skills modules. 3 is encourage throughout the programme. 4 is covered by the Communication and Research Skills module.

Assessment

1 and 2 are assessed through coursework, examinations, literature seminar and dissertation. 3 is indirectly assessed throughout the programme by its influence on performance.

Please note: This specification provides a concise summary of the main features of the programme and the learning outcomes that a typical student might reasonably expect to achieve and demonstrate if he/she takes full advantage of the learning opportunities that are provided. More detailed information on the learning outcomes, content and teaching, learning and assessment methods of each module can be found in module and programme handbooks.