MSc/Postgraduate Diploma in Mathematical and Numerical Modelling of the Atmosphere and Oceans For students entering in 2009

Awarding Institution: Teaching Institution:

Programme length: Date of specification: Programme Director: Board of Studies: Accreditation: University of Reading University of Reading Faculty of Science 12 months July 2009 Dr P.K. Sweby MMP MSc BoS

Summary of programme aims

Both the MSc and PG Diploma courses aim to

- provide a foundation in the theory and techniques of mathematical and numerical modelling for atmosphere and ocean systems;
- provide practical experience in the application and analysis of computational simulation processes used in the environmental sciences;
- 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

<u>MSc</u>

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, at least ONE of which must be from meteorology.

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 fourth week of August.

<u>PG Diploma</u>

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), at least ONE of which must be from meteorology.

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 in the Autumn and SPRING terms.

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.

Autumn Term (introductory modules)MAMI0Elements of Numerical and Functional AnalysisAutumn Term (core modules)MAMA1Numerical Methods for Initial Value ProblemsMAMA3Theory of Differential EquationsMTMG01Introduction to Weather SystemsMTMW99Fluid Dynamics of the Atmosphere and OceansMTMG02Atmospheric PhysicsMAMA5 [†] Computing Techniques and ProjectsAutumn Term (core non-assessed module)	Mod Code	Module Title Cred	its	I	Level
MAMI0Elements of Numerical and Functional Analysis7Autumn Term (core modules)MAMA1Numerical Methods for Initial Value Problems10MAMA3Theory of Differential Equations10MTMG01Introduction to Weather Systems10MTMW99Fluid Dynamics of the Atmosphere and Oceans10MTMG02Atmospheric Physics10MAMA5 [†] Computing Techniques and Projects20Autumn Term (core non-assessed module)	Autumn Tern	ı (introductory modules)			
Autumn Term (core modules)MAMA1Numerical Methods for Initial Value Problems107MAMA3Theory of Differential Equations107MTMG01Introduction to Weather Systems107MTMW99Fluid Dynamics of the Atmosphere and Oceans107MTMG02Atmospheric Physics107MAMA5 [†] Computing Techniques and Projects207Autumn Term (core non-assessed module)107	MAMI0	Elements of Numerical and Functional Analysis			7
MAMA1Numerical Methods for Initial Value Problems107MAMA3Theory of Differential Equations107MTMG01Introduction to Weather Systems107MTMW99Fluid Dynamics of the Atmosphere and Oceans107MTMG02Atmospheric Physics107MAMA5 [†] Computing Techniques and Projects207	Autumn Tern	ı (core modules)			
MAMA3Theory of Differential Equations107MTMG01Introduction to Weather Systems107MTMW99Fluid Dynamics of the Atmosphere and Oceans107MTMG02Atmospheric Physics107MAMA5 [†] Computing Techniques and Projects207Autumn Term (core non-assessed module)7	MAMA1	Numerical Methods for Initial Value Problems	10		7
MTMG01Introduction to Weather Systems107MTMW99Fluid Dynamics of the Atmosphere and Oceans107MTMG02Atmospheric Physics107MAMA5 [†] Computing Techniques and Projects207Autumn Term (core non-assessed module)7	MAMA3	Theory of Differential Equations	10		7
MTMW99Fluid Dynamics of the Atmosphere and Oceans107MTMG02Atmospheric Physics107MAMA5 [†] Computing Techniques and Projects207Autumn Term (core non-assessed module)7	MTMG01	Introduction to Weather Systems	10		7
MTMG02Atmospheric Physics107MAMA5 [†] Computing Techniques and Projects207Autumn Term (core non-assessed module) 20 7	MTMW99	Fluid Dynamics of the Atmosphere and Oceans	10		7
MAMA5 [†] Computing Techniques and Projects 20 7 Autumn Term (core non-assessed module)	MTMG02	Atmospheric Physics	10		7
Autumn Term (core non-assessed module)	$MAMA5^{\dagger}$	Computing Techniques and Projects	20		7
	Autumn Tern	n (core non-assessed module)			
MTMG04 Current Weather Discussions 7	MTMG04	Current Weather Discussions			7
Autumn Term (optional modules)	Autumn Tern	ı (optional modules)			
MAMA10 ^{\dagger} Reading Course 10 7	$MAMA10^{\dagger}$	Reading Course	10		7
MAMA13 Asymptotic Methods 10 7	MAMA13	Asymptotic Methods	10		7
MAMA14 Stochastic Processes 10 7	MAMA14	Stochastic Processes	10		7
Spring Term (core modules)	Spring Torm	(core modules)			
MAMB1 Numerical Methods for Boundary Value Problems 10 7	MAMR1	Numerical Methods for Boundary Value Problems	10	7	
MAMB1 Rumencal Methods for Boundary Value Froblems 10 7 MAMB5 [†] Communication and Research Skills 10 7	MAMR5 [†]	Communication and Research Skills	10	7	

MTMW14	Numerical Modelling of the Atmosphere and Oceans	10	7
Spring Term	(core non-assessed module)		
MAMB6	Industrial Modelling		7
MTMG04	Current Weather Discussions		7
MTMG41	Applications of Meteorology		7
Spring Term	(optional modules)		
MAMB3	Finite Element Methods	10	7
MAMB4	Numerical Techniques for Conservation Laws	10	7
MAMB10	Theory and Techniques of Data Assimilation	10	7
MTMW15	Extra-tropical Weather Systems	10	7
MTMG16	Climate Change	10	7
MTMG19	Tropical Weather Systems	10	7
MTMG21	Oceanography	10	7
MTMW20	Global Circulation of the Atmosphere and Oceans	10	7
MTMG44	Hydrology and Global Change	10	7
MTMG38	Remote Sensing	10	7
Summer Terr	m (core non-assessed module)		
MTMG04	Current Weather Discussions		7
MTMG48	Forecasting Course		7
Summer Terr	m (optional modules)		
MAMC6	Modelling Week	10	7
Summer Terr	m (dissertation/extended essay)		
MAMC4	Dissertation	60	7
MAMC5	Extended Essay	20	7

[†] denotes a module which continues into the following term(s)

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.

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. Assessment is by a mixture of open-note examination, closed book examination, coursework and presentation. Where assessment is by examination this takes place in the vacation following the term in which the module is delivered for core modules and for options during the Easter vacation. All assessed modules contribute to the final mark.

The University's taught post	graduate marks	classification	is as follows:
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<u>Mark</u>	Interpretation
70 - 100%	Distinction
60 - 69%	Merit
50 - 59%	Good standard (Pass)
Failing catego	ories:
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 not exceed 55 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 eligible for a Merit.

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 not exceed 55 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 eligible for a Merit.

Admission requirements

Prior knowledge of meteorology is not necessary. A 1st or 2nd class degree in mathematics or a closely related subject joint with mathematics, or in the physical or environmental sciences with a strong mathematical content is required. Students with other qualifications may be admitted subject to a satisfactory performance in a preparatory (*ad hoc*) course in the preceding year.

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

^{*} 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.

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 Personal Tutors, School Senior Tutors, the Students' Union, the Medical Practice and the Student Services Centre. The Student Services Centre is housed in the Carrington Building and includes the Careers Advisory Service, the Disability Advisory Service, Accommodation Advisory Team, Student Financial Support, Counselling and Study Advisors. Student Services has a Helpdesk available for enquiries made in person or online (www.risisweb.reading.ac.uk), or by calling the central enquiry number on (0118) 378 5555. Students can get key information and guidance from the team of Helpdesk Advisers, or make an appointment with a specialist adviser; Student Services also offer drop-in sessions on everything from accommodation to finance. The Carrington Building is open between 8:30 and 17:30 Monday to Thursday (17:00 Friday and during vacation periods). Further information can be found in the Student Diary (given to students at enrolment) or on the Student website (www.reading.ac.uk/student).

Career prospects

The majority of graduates from the course will pursue careers in the mathematical and environmental sciences. The course will provide the skills and knowledge base for a wide range of careers including:

- Research and forecasting posts in national meteorological services (including The Met. Office)
- Research work and technical posts in universities
- Research and technical posts in other environmental science institutes (such as the Institute of Hydrology and Hydraulics Research Wallingford)
- Research posts in environmental science consultancy firms
- Forecasting and analysis in meteorological consultancies

Opportunities for study abroad or for placements

None

Educational aims of the programme

The Mathematical and Numerical Modelling of the Atmosphere and Oceans covers a wide variety of mathematical and meteorological topics and technical skills, with a variety of potential applications and career opportunities. The general aim of the Course is to convert new graduate from first degree courses containing a significant amount of mathematics into postgraduates possessing a deeper insight into the modelling of environmental problems, together with practical competence in the application and analysis of numerical techniques.

At the end of the Course students will have gained problem solving and transferable skills, have the skills necessary to pursue academic research or further study, and have enhanced their career opportunities.

Programme Outcomes:

Knowledge and Understanding

A. Knowledge and understanding of:	Teaching/learning methods and
	strategies
 basic theory of differential equations, including well- posedness; 	The knowledge is delineated through formal lectures supported by guided
2. Classical finite difference schemes for numerical solution of initial and boundary value problems;	solutions are provided and feedback given.
3. aspects of computational grids and their generation;	Feedback on the programming is given initially via non-assessed programming
4. types of problems encountered in industry and techniques for their	exercises, and later assessed projects.
solution;	The industrial expertise is delivered in a
5. the C++ and FORTRAN 90	series of lectures by outside industrial
programming languages.	speakers. (MAMB6).
6. the physical processes which drive the atmospheric system	
giving rise to weather and climate;	Assessment
7. the feedback between the earth's	Understanding is tested through open
surface and the atmosphere and	note examinations and course work.
the impact of these feedback	
processes on weather and climate.	

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 mathematics 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:

- 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;
- 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 be expected 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 the module description and in the programme handbook. The University reserves the right to modify this specification in unforeseen circumstances, or where the process of academic development and feedback from students, quality assurance processes or external sources, such as professional bodies, requires a change to be made. In such circumstances, a revised specification will be issued.