MMath Mathematics and Meteorology

UCAS code: GFC9

For students entering Part 1 in 2003

Awarding Institution: The University of Reading
Teaching Institution: The University of Reading
Relevant QAA subject benchmarking group(s): Mathematics, Statistics and Operational Research , and ES3

Faculty of Science
Programme length: 4 years
Date of specification: 31-Mar-06
Programme Director: Dr P. A. Mulheran
Programme Adviser: Dr J. A. Leach (Mathematics), Dr E. J. Highwood (Meteorology)
Board of Studies: Mathematics, Meteorology and Physics
Accreditation: Approved by the Royal Meteorological Society as an appropriate academic training for meteorologists seeking the qualification *Chartered Meteorologist*.
Approved by the Institute of Mathematics and its Applications as an appropriate academic training for mathematicians seeking the qualification *Chartered Mathematician*.

Summary of programme aims

The MMath programme in Mathematics and Meteorology aims to provide a thorough background in both subjects with special reference to the interdependence of the two disciplines in the modelling of the atmosphere and environmental physical science, with emphasis on the Earth's atmosphere and oceans. It aims to be particularly suitable for those intending to pursue a career in either of the two subjects but also to provide graduates with a sufficient background and range of appropriate transferable skills to enable them to pursue a career outside their specialist area. (For a full statement of the programme aims and learning outcomes see below.)

Transferable skills

The University's Strategy for Teaching and Learning has identified a number of generic transferable skills which all students are expected to have developed by the end of their degree programme. In following this programme, students will have had the opportunity to enhance their skills relating to career management, communication (both written and oral), information handling, numeracy, problem-solving, team working and use of information technology.

By the end of the programme students are expected to have gained experience and show competence in the following transferable skills: IT (word-processing, using standard and mathematics software, spreadsheet and graphical applications programs, scientific programming, internet), scientific writing, oral presentation, team-working, problem-solving, use of library resources, time-management, career management and planning.

Programme content

The profile which follows states which modules must be taken (the compulsory part), together with one or more lists of modules from which the student must make a selection (the "selected" modules). Students must choose such additional modules as they wish, in consultation with their programme adviser, to make 120 credits in each Part. The number of modules credit for and the level of each module are shown after its title.

Part 1 (three terms)		*Credits*	*Level*
Compulsory modules			
MA11A	*Introduction to Analysis*	20	C
MA11B	*Calculus and Applications*	20	C
MA11C	*Matrices*, *Vectors and Applications*	20	C
MT11A	*Introduction to Atmospheric Science*	20	C
MT11B	*Weather Systems Analysis*	20	C
Either			
MA11D	*Introduction to Algebra*	20	C
or			
	Language	20	C

Part 2 (three terms)		*Credits*	*Level*
Compulsory modules			
MA24A	*Analysis*	20	I
MA24B	*Differential Equations*	20	I
MA24C	*Vectors, Dynamics and Numerical Analysis*	20	I
MT24A	*Atmosphere and Ocean Dynamics*	20	I
MT24B	*Atmospheric Physics*	20	I
MT24C	*Numerical Methods for Environmental Science*	10	I
MT25D	*Skills for Graduates*	10	I

Part 3 (three terms)		*Credits*	*Level*
Compulsory modules			
MA37J	*Fluid Dynamics and Mathematics Project*	20	H
MA37A	*Complex Analysis and Calculus of Variations*	20	H
MT38A	*Global Circulation*	10	M
MT38C	*Numerical Weather Prediction*	10	M
MT38B	*Climate Change*	10	M

Optional modules:
(i) Three modules from list A and one from list Y.
List A:

MT37C	*Data Processing Methods in Weather Climate Research*	10	H
MT4XD	*Remote Sensing*	10	M
MT38D	*Advanced Weather Systems Analysis*	10	H
MT4XF	*Oceanography*	10	M

List Y

MA37E	*Numerical Analysis and Dynamical Systems 1*	20	H
MA37L	*Analysis and Topology*	20	H
MA3M7	*Lagrangian Mechanics and Viscous Fluid Dynamics* †	20	M
MA3N7	*Reaction-Diffusion Theory* †	20	M

(† only one of these will be available in any given year.)

Part 4 (three terms)		*Credits*	*Level*
Compulsory modules			
MT4XA	*Meteorology Project*	30	M

MT37B	*General Studies*	10	I
MT4XE	*Dynamical Weather Systems*	10	M
MA4XB	*Advanced Topics in Mathematics*	20	M

Optional modules
(ii) 10 credits from list A and 20 credits from list Z and **either** MT36E *Boundary Layer Meteorology* (20 credits at H level) **or** 20 additional credits from lists A, Y and Z.

List Z

MA34E	*Linear Algebra and Coding Theory*	20	H
MA3C7	*Boundary-Value Problems* †	10	H
MA3D8	*Asymptotic Methods* †	10	H
MA3M7	*Lagrangian Mechanics and Viscous Fluid Dynamics* †	20	M
MA3N7	*Reaction-Diffusion Theory* †	20	M
MA4XE	*Numerical Solution of Differential Equations*	20	M
MA4XC	*Spectral Theory and Integral Equations*	20	M
MA4XF	*Dynamical Systems 2*	10	M

(† a selection of these will be available in any given year.)

(iv) The optional modules must be selected so that a total of at least 100 credits at level M are included.

Progression requirements
To proceed to Part 2 it is sufficient to obtain an average of at least 40% overall, at least 40% in the Part 1 Mathematics modules taken together, at least 40% in the Meteorology modules averaged together, with no module mark below 30%. Marks of less than 30% in a total of 20 credits, except for MA11A, MA11B, MA11C, MT11A, MT11B, will be condoned provided that the candidate has pursued the course for the module with reasonable diligence and has not been absent from the examination without reasonable cause.

To gain a threshold performance at Part 2 and qualify for the DipHE a student shall normally be required to achieve an overall average of 40% over 120 credits taken in Part 2, and a mark of at least 30% in individual modules amounting to not less than 100 credits. In order to progress from Part 2 to Part 3, a student shall normally be required to achieve a threshold performance at Part 2 and achieve an overall average of 50% over120 credits taken in Part 2 (of which not less than 100 credits should normally be at I level or above).

Summary of teaching and assessment
Teaching is organised in modules that typically involve both lectures and problems. The assessment is carried out within the University's degree classification scheme, details of which are in the programme handbooks. The pass mark in each module is 40%. Modules in Part 1 and 2 are assessed by a mixture of coursework and formal examination. In Parts 3 and 4 there are some modules which are assessed wholly by coursework and others wholly by examination; the details are given in the module descriptions.

Part 2 contributes 20% of the final assessment, Part 3 30% and Part 4 the remaining 50%.

Admission requirements
Entrants to this programme are normally required to have obtained:

Grade C or better in English in GCSE and in GCSE Physics or Combined Science if not taken at A-Level; and achieved
UCAS Tariff: A Level: 320 points including grade B in A Level Mathematics; or
International Baccalaureat: 30 points including 6 in Higher Mathematics; or
Advanced GNVQ: Merit in one of the following subject areas: Engineering, Information Technology or Science, accompanied by A Level Mathematics Grade B or
Scottish Highers: Grade A in Mathematics and As in two other subjects and C in a third.
Irish Leaving Certificate: Grade A in Mathematics and three Bs and a C in four other subjects
Two AS grades are accepted in place of one A-Level other than in Mathematics.

Admissions Tutor: Dr Graham Williams

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 Personal Tutors, the Careers Advisory Service, the University's Special Needs Advisor, Study Advisors, Hall Wardens and the Students' Union.

Within the providing Departments additional support is given through practical classes and problem solving classes. The Department of Meteorology Library holds all textbooks used in connection with the programme, and also contains a Learning Resource Centre containing additional material such as course notes, reprints of important papers, and past examination papers. There is a Course Adviser to offer advice on the choice of modules within the programme.

Career prospects
This programme is new. It is expected to have similar destinations to the BSc programme in Mathematics and Meteorology, whose graduates in recent years have gone into jobs as actuarial trainee, trainee chartered accountant, teaching, business analyst and to postgraduate study.

Opportunities for study abroad or for placements
There are no formal arrangements for the Mathematics and Meteorology programme (but see programme specification for the 4-year Meteorology programme, which includes one year of advanced study at the University of Oklahoma, USA).

Educational aims of the programme
The MMath programme in Mathematics and Meteorology aims to provide a thorough background in both subjects with special reference to the interdependence of the two disciplines in the modelling of the atmosphere and environmental physical science, with emphasis on the Earth's atmosphere and oceans. It aims to be particularly suitable for those intending to pursue a career in either of the two subjects but also to provide graduates with a

sufficient background and a range of appropriate transferable skills to enable them to pursue a career outside their specialist area.

Programme Outcomes

The programme provides opportunities for students to develop and demonstrate knowledge and understanding, skills, qualities and other attributes in the following areas:

Knowledge and Understanding

A. Knowledge and understanding of:	**Teaching/learning methods and strategies**
1. the fundamental concepts and techniques of calculus, analysis, linear algebra, dynamics and numerical mathematics 2. applicable areas of mathematics, such as differential equations, fluid mechanics, and numerical analysis 3. the application of physical and mathematical methods to the description, modelling and prediction of physical phenomena in the atmosphere and oceans 4. impacts of weather, climate and climate change on society and ecology 5. the application of theoretical ideas 6. a selection of more specialist optional topics in mathematics and of current research interest in the Earth's climate system 7. project work on an advanced topic, forming a substantial independent investigation.	The knowledge required for the basic topics is delineated in formal lectures supported by problem sets for students to tackle on their own. In Part 1 these are supported by tutorials and practical classes through which students can obtain feedback on their non-assessed work. For the more specialist topics this is enhanced through self-learning based on guided reading, problem solving and project work. The knowledge required for 4 is gained from weekly discussion classes during part 3. Feedback on most of 1 - 3 is provided through formative assessed work. *Assessment* Most knowledge is tested through a combination of coursework and unseen formal examinations. Dissertations and oral presentations also contribute in other parts of the programme. 4 - 6 are tested in various modules in Parts 3 and 4. 7 is tested in the final year project.

Skills and other attributes

B. Intellectual skills – able to:

1. think logically
2. analyse and solve problems
3. recognise and use subject-specific theories, paradigms, concepts and principles
4. analyse, synthesise and summarise information critically
5. apply knowledge and understanding to address familiar and unfamiliar problems
6. collect and integrate evidence to formulate and test hypotheses
7. conduct a substantial independent study of a chosen topic and report on the results.
8. integrate theory and applications
9. appreciate moral and ethical issues relating to the subject area

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Teaching/learning methods and strategies

Logic is an essential part of the understanding and construction of mathematical proofs is embedded throughout the mathematics programme. The quality of a solution to a problem is substantially determined by the structure of that response; analysis, synthesis, problem solving, integration of theory and application, and knowledge transfer from one topic to another are intrinsic to high-level performance in the programme.

Most modules are designed to develop 1-5. 4 - 6 are enhanced through the use of coursework assignments, fieldwork and project work. 6 - 8 are promoted mainly by project work. 9 is addressed in discussion classes.

Assessment

1- 4 are assessed indirectly in most parts of Mathematics, while 5 contributes to the more successful work. 7 is assessed in the project report and as part of the module *Topics in Applied Mathematics*. 9 is assessed by a general paper.

C. Practical skills – able to:

1. understand and construct mathematical proofs
2. formulate and solve mathematical problems
3. plan, conduct, and report on investigations, including the use of secondary data
4. write and defend a report on a chosen topic
5. reference work in an appropriate manner
6. analyse numerical methods and respond to the issues of accuracy, stability and convergence.

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Teaching/learning methods and strategies

1 is taught in Part 1 lectures and reinforced in practical classes. 2 is introduced in lectures in Part 1 and forms a large part of subsequent mathematics. 3 is emphasised through guidelines and advice given to students in connection with practical work. 4 and 5 are emphasised through guidelines issued to students in connection with project work. Numerical analysis courses introduce and develop the ideas in 6, which are illustrated by practical tasks.

Assessment

1 and 2 are tested both formatively in coursework and summatively in examinations. 3 and 4 are assessed through the project dissertation and its oral presentation.

D. Transferable skills – able to:

1. use IT (word-processing, using standard and mathematical software, scientific programming)
2. communicate scientific ideas
3. give oral presentations
4. interpersonal skills: ability to work with others and share knowledge effectively; recognise and respect the views and opinions of other team members.
5. use library resources
6. use the internet critically as a source of information.
7. apply self management and professional development: study skills, independent learning, time management, identifying and working towards targets for personal, academic and career development

Teaching/learning methods and strategies

The use of IT is common throughout the programme, and in the package *Mathematica* taught in Part 1 mathematics. Team work and career planning are part of one Part 2 module. Communication skills are the focus of one module in Part 2, and these are deployed in the final year project. Time management is essential for the timely and effective completion of the programme. Library resources are required for the final year project, and contribute to the best performances throughout.

Assessment

1 and 2 are assessed through coursework. 5 is enhanced partly through the provision of a Career Development Skills module during part 2, and partly through a PAR tutorial system. 5 is partly assessed through the project. The other skills are not directly assessed but their effective use will enhance performance in later modules.

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.