**MMath Mathematics and Meteorology** **UCAS code: GFC9**
**For students entering Part 1 in 2013/4**

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|---|---|
| Awarding Institution: | University of Reading |
| Teaching Institution: | University of Reading |
| Relevant QAA subject Benchmarking group(s): | Mathematics, Statistics and Operational Research, and ES3 |
| Faculty: | Science Faculty |
| Programme length: | 4 years |
| Date of specification: | 10/Apr/2015 |
| Programme Director: | Dr Karen Ayres |
| Programme Advisor: | Dr Peter Inness<br>Dr Karen Ayres |
| Board of Studies: | School of Mathematical and Physical Sciences |
| Undergraduate Accreditation: | Approved by the Royal Meteorological Society as an appropriate academic training for meteorologists seeking the qualification *Chartered Meteorologist.* Accredited by the Institute of Mathematics and its Applications to meet the educational requirements of the Chartered Mathematician designation. |
| Optional placement variation(s): | with Placement Experience |

**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.

**Transferable skills**
During the course of their studies at Reading, all students will be expected to enhance their academic and personal transferable skills. In following this programme, students will have had the opportunity to develop such skills, in particular relating to communication (both written and oral), information handling, numeracy, team working, use of IT and problem-solving and will have been encouraged to further develop and enhance the full set of skills through a variety of opportunities available outside their curriculum.
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 optional 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 credits and the level of each module are shown after its title.

**Part 1 (three terms)**
*Compulsory modules*

| Code | Module Code | Credits | Level |
|---|---|---|---|
| MT11C | Introduction to Meteorology | 20 | 4 |
| MT11D | Weather and Climate Fundamentals | 20 | 4 |
| MA1FM | Foundations in Mathematics | 20 | 4 |
| MA1MM1 | Mathematical Methods I | 20 | 4 |
| MA1MM2 | Mathematical Methods II | 10 | 4 |
| MA1LIN | Linear Algebra | 10 | 4 |

*Choose 20 credits from the following*:

| | | | |
|---|---|---|---|
| PH101 | Physics of the Natural World | 20 | 4 |
| MA1ALG | Algebra I | 10 | 4 |
| MA1GEO | Geometry | 10 | 4 |
| MA1MMP | Modelling and Mathematical Physics | 10 | 4 |
| ST1PD | Probability and Distributions | 10 | 4 |
| MT12C | Skills for Environmental Science | 20 | 4 |

**Part 2 (three terms)**
*Compulsory modules*

| *Code* | *Module title* | *Credits* | *Level* |
|---|---|---|---|
| MA2RA1 | Real Analysis I | 20 | 5 |
| MA2ODE | Ordinary Differntial Equations | 10 | 5 |
| MA2PDE | Partial Differntial Equations | 10 | 5 |
| MA224C | Numerical Methods for Environmental Science | 10 | 5 |
| MA2VC | Vector Calculus | 10 | 5 |
| MT24A | Atmosphere and Ocean Dynamics | 20 | 5 |
| MT24B | Atmospheric Physics | 20 | 5 |
| MT25D | Skills for Graduates | 10 | 5 |

*Optional Modules*
*Choose one of:*

| *Code* | *Module title* | *Credits* | *Level* |
|---|---|---|---|
| MA2MM | Mathematical Modelling | 10 | 5 |
| MA2ALG | Algebra I | 10 | 5 |
| MA2AL2 | Algebra II | 10 | 5 |
| MA2PT1 | Probability Theory I | 10 | 5 |

**Part 3 (three terms)**
*Compulsory modules*

| *Code* | *Module title* | *Credits* | *Level* |
|---|---|---|---|
| MA3CA1 | Complex Analysis I | 10 | 6 |
| MA3RA2 | Real Analysis II | 10 | 6 |
| MT37B | General Studies | 10 | 6 |
| MT38B | Climate Change | 10 | 6 |
| MT38A | The Global Circulation | 10 | 6 |
| MA3PR | Part 3 Project | 10 | 6 |

*Optional modules*
*(i) Choose 30 credits from:*

| | | | |
|---|---|---|---|
| MT37D | Remote Sensing Methods and Applications | 10 | 6 |
| MT24E | Forecasting: Practice and Presentation* | 10 | 5 |
| MT37F | Oceanography | 10 | 6 |
| MT38C | Numerical Weather Predictions | 10 | 6 |
| MT38E | Atmospheric Electricity | 20 | 6 |

* This module is subject to an upper limit of 16 students.

(ii) *Choose 30 credits from:*

| | | | |
|---|---|---|---|
| MA3DS | Dynamical Systems | 10 | 6 |
| MA3CV | Calculus of Variations | 10 | 6 |
| MA3CEC | Cryptography and Error Correcting Codes | 10 | 6 |
| MA3FM | Fluid Mechanics | 10 | 6 |
| MA3WW | Water Waves | 10 | 6 |
| MA3AGT | Applied Graph Theory | 10 | 6 |
| MA3PD2 | Partial Differential Equations II | 10 | 6 |
| MA3NAT | Numerical Analysis II | 20 | 6 |
| MA3MB | Mathematical Biology | 10 | 6 |
| MA3Z7 | Number Theory | 10 | 6 |
| MA3CM | Classical Mechanics | 10 | 6 |
| ST3MVA | Multivariate Data Analysis | 10 | 6 |

**Part 4 (three terms)**
*Compulsory modules*

| *Code* | *Module title* | *Credits* | *Level* |
|---|---|---|---|
| MT4XA | Part 4 Project | 40 | 7 |
| MT4XE | Dynamics of Weather Systems | 10 | 7 |

*Optional modules*
(i) Choose at least 50 credits from:

| | | | |
|---|---|---|---|
| MA3ASP | Applied Stochastic Processes | 10 | 7 |
| MA4NSO | Numerical Solution of Ordinary Differential Equations | 10 | 7 |
| MA4NSP | Numerical Solution of Partial Differential Equations | 10 | 7 |
| MA4AM | Asymptotic Methods | 20 | 7 |
| MA4DA | Theory and Techniques of Data Assimilation | 10 | 7 |
| MA4SMA | Statistical Mechanics and Applications | 10 | 7 |

(ii) Choose additional Level 7 modules totalling at most 20 credits. These can be selected from:

| | | | |
|---|---|---|---|
| MT4XF | Oceanography | 10 | 7 |
| MT4YG | Extratropical Weather Systems | 10 | 7 |
| MT4YD | Tropical Weather Systems | 10 | 7 |
| MT4YF | Numerical Modelling of the Atmosphere and Oceans | 10 | 7 |
| MT4XD | Remote Sensing Methods and Applications | 10 | 7 |
| MT4YC | Numerical Weather Prediction | 10 | 7 |
| MT49E | Boundary Layer Meteorology | 20 | 7 |

**Progression requirements**
To gain a threshold performance at Part 1 and qualify for the CertHE a student shall normally be required to achieve an overall weighted average of 40% over 120 credits taken in Part 1, where all the credits are at level 4 or above, and a mark of at least 30% in individual modules amounting to not less than 100 credits. In order to progress from Part 1 to Part 2, a student shall normally be required to achieve a threshold performance at Part 1 and obtain a weighted average of at least 40% over the modules MA1MM1, MA1MM2, MA1LIN, MA1FM and obtain a weighted average of at least 40% over the modules MT11C, MT11D and obtain marks of at least 30% in these six modules.

To gain a threshold performance at Part 2, a student shall normally be required to achieve:
(i) a weighted average of 40% over 120 credits taken at Part 2;
(ii) marks of at least 40% in individual modules amounting to not less than 80 credits; and
(iii) marks of at least 30% in individual modules amounting to not less than 120 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 weighted average of 50% over 120 credits taken in Part 2 (of which not less than 100 credits should normally be at level 5 or above). Students who fail to progress are permitted one re-sit examination in each module in which they obtain less than 50%. For any module passed in a re-sit examination the maximum mark carried forward into the final degree classification will be the higher of (a) the first attempt mark and (b) the lower of 40 and the mark achieved in the re-examination. Students who do not meet the requirements for progression on the MMath but gain a threshold performance at Part 2 are eligible to transfer to BSc Mathematics and Meteorology.

Students are required to pass the professional/placement year in order to progress on the programme which incorporates the professional/placement year. Students who fail the professional/placement year transfer to the non-placement year version of the programme.

In order to progress from Part 3 to Part 4, a student shall normally be required to achieve an overall weighted average of 40% over 120 credits taken in Part 3, and a mark of at least 30% in individual modules amounting to not less than 100 credits. Students who fail to progress are permitted one re-sit examination in each module in which they obtain less than 40%. For any module passed in a re-sit examination the maximum mark carried forward into the final degree classification will be the higher of (a) the first attempt mark and (b) the lower of 40 and the mark achieved in the re-examination. Students who do not meet the requirements for progression to Part 4 will be eligible for the award of BSc Mathematics and Meteorology, provided they have achieved a threshold performance. The classification for the BSc programme will be based on one third of the overall weighted average in Part 2 and two-thirds of the overall weighted average in Part 3.

**Assessment and classification**
The University's honours classification scheme is:

| *Mark* | *Interpretation* |
|---|---|
| 70% - 100% | First class |
| 60% - 69% | Upper Second class |
| 50% - 59% | Lower Second class |
| 40% - 49% | Third class |
| 35% - 39% | Below Honours Standard |
| 0% - 34% | Fail |

For the University-wide framework for classification, which includes details of the classification method, please see: www.reading.ac.uk/internal/exams/Policies/exa-class.aspx

The weighting of the Parts/Years in the calculation of the degree classification is

**Integrated Masters programmes (MEng, MMath, MChem, etc)**

Part 2 20%
Part 3 30%
Part 4 50%
Teaching is organised in modules that typically involve both lectures and problems. 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.

**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: AAB with grade A in A Level Mathematics;
- International Baccalaureat: 35 points including 6 in Higher Mathematics.

Equivalent qualifications are acceptable.

**Admissions Tutor:** Dr Stephen Langdon

**Support for students and their learning**
University support for students and their learning falls into two categories. Learning support is provided by a wide array of services across the University, including: the University Library, the Careers, Placement and Experience Centre (CPEC), In-sessional English Support Programme, the Study Advice and Mathematics Support Centre teams, IT Services and 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 advisers in the Student Services Centre. The Student Services Centre is housed in the Carrington Building and offers advice on accommodation, careers, disability, finance, and wellbeing, academic issues (eg problems with module selection) and exam related queries. 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 and runs workshops and seminars on a range of topics. For more information see www.reading.ac.uk/student

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 Programme Adviser to offer advice on the choice of modules within the programme.

**Career learning**

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

**Placement opportunities**
A version of this programme to include a maxi placement is available. Students undertaking a maxi placement spend a year in industry between the second and third taught year. This year does not contribute to the final degree classification.

**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<br>2. Applicable areas of mathematics, such as differential equations, fluid mechanics, and numerical analysis<br>3. The application of physical and mathematical methods to the description, modelling and prediction of physical phenomena in the atmosphere and oceans<br>4. Impacts of weather, climate and climate change on society and ecology<br>5. The application of theoretical ideas<br>6. A selection of more specialist optional topics in mathematics and of current research interest in the Earth's climate system<br>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.<br>Feedback on most of 1 - 3 is provided through formative assessed work.<br><br>*Assessment*<br>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:* | **Teaching/learning methods and strategies** |
|---|---|
| 1. Think logically<br>2. Analyse and solve problems<br>3. Recognise and use subject-specific theories, paradigms, concepts and principles<br>4. Analyse, synthesise and summarise information critically<br>5. Apply knowledge and understanding to address familiar and unfamiliar problems<br>6. Collect and integrate evidence to formulate and test hypotheses<br>7. Conduct a substantial independent study of a chosen topic and report on the results<br>8. Integrate theory and applications<br>9. Appreciate moral and ethical issues relating to the subject area | 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.<br>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.<br><br>*Assessment*<br>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 project module. 9 is assessed by a general paper. |

| **C. Practical skills** - *able to:* | **Teaching/learning methods and strategies** |
|---|---|
| 1. Understand and construct mathematical proofs<br>2. Formulate and solve mathematical problems<br>3. Plan, conduct, and report on investigations, including the use of secondary data<br>4. Write and defend a report on a chosen topic<br>5. Reference work in an appropriate manner<br>6. Analyse numerical methods and respond to the issues of accuracy, stability and convergence | 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. 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 projects. Time management is essential for the timely and effective completion of the programme. Library resources are required for the projects, and contribute to the best performances throughout.

*Assessment*
1 and 2 are assessed through coursework. 5 is enhanced through the provision of a Career Development Skills module during part 2. 5 is partly assessed through the project. The other skills 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 process or external sources, such as professional bodies, requires a change to be made. In such circumstances, a revised specification will be issued.**