# BSc Computational Mathematics

**UCAS code: G1G4**

**For students entering Part 1 in 2005**

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

Faculty of Science
Programme length: 3 years
Date of specification: 31-Mar-06
Programme Director: Dr P. A. Mulheran
Programme Adviser: Dr J. A. Leach
Board of Studies: Mathematics, Meteorology and Physics
Accreditation: 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 programme aims to provide a thorough degree-level education in Mathematics, with some emphasis on the computational aspects, along with topics from Computer Science which will support this and provide an appreciation of wider issues. It aims to produce mathematicians who have some experience of numerical techniques, an appreciation of wider computational issues and a range of appropriate subject-specific and transferable skills. (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.

As part of this programme students are expected to have gained experience and show competence in the following transferable skills: IT (word-processing, using standard and mathematical software, scientific programming), scientific writing, oral presentation, team-working, problem-solving, use of library resources, time-management, and career planning and management.

**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* | | | |
| SE1SA5 | *Programming* | 20 | C |
| MA11A | *Introduction to Analysis* | 20 | C |

| | | | |
|---|---|---|---|
| MA11B | *Calculus and Applications* | 20 | C |
| MA11C | *Matrices, Vectors and Applications* | 20 | C |
| MA11D | *Introduction to Algebra* | 20 | C |

*Optional modules*
***Either***

| | | | |
|---|---|---|---|
| SE1SC5 | *Computer Science Roadmap* | 20 | C |

***or***

| | | | |
|---|---|---|---|
| SE1TQ5 | *Commercial off-the-shelf Software 1* | 20 | *C* |

| **Part 2 (three terms)** | | *Credits* | *Level* |
|---|---|---|---|
| *Compulsory modules* | | | |
| CS2D2 | *Databases* | 10 | I |
| CS2A6 | *Compilers* | 10 | I |
| CS2F6 | *Collaborative Design and Programming* | 20 | I |
| MA24B | *Differential Equations* | 20 | I |
| MA24J | *Vectors Calculus and Numerical Analysis* | 20 | I |
| MA24E | *Linear Algebra and Coding Theory* | 20 | I |
| MA24F | *Communicating Mathematics* | 20 | I |

| **Part 3 (three terms)** | | *Credits* | *Level* |
|---|---|---|---|
| *Compulsory modules* | | | |
| MA34A | *Analysis* | 20 | H |
| MA37E | *Numerical Analysis and Dynamical Systems I* | 20 | H |

*Optional modules:*
(i)*One of*

| | | | |
|---|---|---|---|
| MA37B | *Topics in Applied Mathematics* | 20 | H |
| MA37C | *Topics in Pure Mathematics* | 20 | H |

(ii) *Part 3 modules in Computer Science to the value of 40 credits, selected two groups from:*

| | | | |
|---|---|---|---|
| **Group A** | | | |
| CS3F6 | *XML and Semantics Web Technologies and Applications* | 10 | H |
| CS3E6 | *Distributed Computing* | 10 | H |
| **Group B** | | | |
| CS3A2 | *Computer Networks* | 10 | H |
| CS3TZ4 | *Network Security* | 10 | H |
| **Group C** | | | |
| CS3L2 | *Neural Computation* | 10 | H |
| CS3M6 | *Evolutionary Computation* | 10 | H |

(iii) *Additional modules to make a total of 120 credits in Part 3, with at least 100 credits at level H.*

**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 average of 40% over 120 credits taken in Part 1,where all the credits are at C level 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 to have obtained at least 40% in the Mathematics modules averaged together and at least 40% in each of the three Computer Science modules and have no module mark below 30%.

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.

**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. 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 one third of the final assessment and Part 3 the remaining two thirds.

**Admission requirements**

Entrants to this programme are normally required to have obtained:
Grade C or better in English in GCSE; and achieved
UCAS Tariff: A Level: 300 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 two Bs and a C in three other subjects.
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 except 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 contributing departments additional support is given though practical classes in Part 1. The development of problem-solving skills is assisted by extensive provision of

model solutions to problems. There is a Course Adviser to offer advice on the choice of modules within the programme.

**Career prospects**

This programme replaces the Mathematics and Computer Science programme. In recent years students who have followed that programme have gone into jobs in software development, teaching and the army as well as to postgraduate study. In recent years students who have followed this programme have gone into jobs as actuarial trainee, trainee chartered accountant, teaching, business analyst and postgraduate study.

**Opportunities for study abroad or for placements**

Although there are no formal arrangements for the Computational Mathematics programme, informal arrangements may be possible. The Department of Computer Science participates in a Socrates exchange under which students can spend time at the University of Merseburg in Germany.

**Educational aims of the programme**

The programme aims to provide a thorough degree-level education in Mathematics, with some emphasis on the computational aspects, along with topics from Computer Science which will support this and provide an appreciation of wider issues. It aims to produce mathematicians who have some experience of numerical techniques, an appreciation of wider computational issues and a range of appropriate subject-specific and transferable skills.

**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, algebra, dynamics and numerical mathematics<br>2. the use of the basic techniques of mathematics in applicable areas of mathematics, such as differential equations, coding theory and numerical analysis<br>3. a selection of more specialist optional topics<br>4. a mainstream programming language<br>5. software engineering and theoretical issues in Computer Science. | 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.<br>Feedback on programming is initially given through tutorials and formative assessed work.<br>In the later parts of the course students are expected to work at additional problems on their own and seek help when required, using the office hours of staff. Model solutions are provided for problems set.<br><br>*Assessment*<br>Most knowledge is tested through a combination of coursework and unseen formal examinations, although 4 is principally assessed by coursework. Dissertations and oral presentations also contribute in other parts of the programme. |

## *Skills and other attributes*

**B. Intellectual skills** – able to:

1. think logically
2. analyse and solve problems
3. organise tasks into a structured form
4. evaluate the evolving state of knowledge in a rapidly developing area
5. transfer appropriate knowledge and methods from one topic within the subject to another
6. conduct independent study of a chosen topic and report on the results.

**Teaching/learning methods and strategies**

Logic is an essential part of the understanding and construction of mathematical proofs and structured computer programs and is embedded throughout the 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. The rapid evolution of modern Computer Science forms part of optional modules in Part 3.

*Assessment*

1- 3 are assessed indirectly in most parts of Mathematics, while 5 contributes to the more successful work. 6 is assessed in the numerical analysis project report. 4 contributes to some Computer Science options.

**C. Practical skills** – able to:

1. understand and construct mathematical proofs
2. formulate and solve mathematical problems
3. program a computer in a structured and effective way
4. analyse numerical methods and respond to the issues of accuracy, stability and convergence
5. write a report on a chosen topic.

**Teaching/learning methods and strategies**

Mathematical proof is taught in Part 1 lectures and reinforced in practical classes. Problem solving is introduced in lectures in Part 1 and forms a large part of subsequent Mathematics. Numerical analysis courses introduce and develop the ideas of accuracy, stability and convergence, illustrated by practical tasks. Parts 1 and 2 Computer Science modules introduce various styles of programming and discuss their advantages.

*Assessment*

1 and 2 are tested both formatively in coursework and summatively in examinations. 3 is assessed practically through coursework and the principles through formal examination. 4 and 5 are assessed through coursework and examination, also through the computational project report.

**D. Transferable skills** – able to:

1. use IT (word-processing, using standard and mathematical software)
2. communicate scientific ideas
3. give oral presentations
4. work as part of a team
5. use library resources
6. manage time
7. plan their career.

**Teaching/learning methods and strategies**

The use of IT is embedded throughout the computational side of the course, and in the package *Mathematica* taught in Part 1 mathematics. Oral presentations, 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 small project within one Part 2 module and the final year project, and contribute to the best performances throughout.

*Assessment*

1 and 2 are assessed through coursework. 3 - 5 contribute assessed coursework towards the Part 2 module *Communicating Mathematics,* and 2, 3 and 5 also in 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.**