OXFORD BROOKES UNIVERSITY

# Programme Specification

# BSc (Hons) Mathematical Sciences

Valid from: September 2016

## Faculty of Technology, Design and Environment

*T2.7 2014-15*

## SECTION 1: GENERAL INFORMATION

| | |
|---|---|
| Awarding body: | Oxford Brookes University |
| Teaching institution and location: | Oxford Brookes University |
| Final award: | BSc (Hons) |
| Programme title: | Mathematical Sciences |
| Interim exit awards and award titles: | CertHE, DipHE, BSc |
| Brookes course code: | ML |
| UCAS/UKPASS code: | G140 |
| JACS code: | G100 |
| Mode of delivery: | Face to face |
| Mode/s and duration of study: | Full Time: typically 3 years<br>Sandwich mode: typically 4 years<br>Part Time: typically 6 years<br>Maximum 8 years |
| Language of study: | English |
| Relevant QAA subject benchmark statement/s: | Mathematics, Statistics and Operational Research (2015) |
| External accreditation/recognition: *(applicable to programmes with professional body approval)* | Accredited by the Institute of Mathematics and its Applications (IMA) to meet the educational requirements of the Chartered Mathematician designation when followed by subsequent training and experience in employment to obtain competencies to those specified by the QAA for taught masters degrees.<br>http://www.ima.org.uk/ |
| Faculty managing the programme: | Faculty of Technology, Design and Environment |
| Date of production (or most recent revision) of specification: | September 2015 |

## SECTION 2: OVERVIEW AND PROGRAMME AIMS

### 2.1 Rationale for and/or Distinctive features of the programme

This programme is designed to develop the academic, vocational and creative skills of students and prepare them for careers in a wide range of numerate and analytic professions.

A distinguishing feature of this course is the emphasis on real-world applications of the mathematics and statistics studied, leading to enhanced graduate employability. Students are able to tailor their degree to suit their own career aspirations, by choosing pathways which focus on core mathematics and statistics, together with a broad range of modules.

The first year of the BSc Mathematics, the BSc Mathematical Sciences and the MMath in Mathematics programmes are identical, allowing transfer between courses. In addition, students may opt to transfer to the MMath in Mathematics at the end of the second year. Such transfers are dependent on suitable academic progress being made, and assume that all compulsory modules for the chosen programme will be taken and passed. The compulsory modules for the MMath in Mathematics are shown in section 4.1 of this document, and students considering a transfer to the programme should ensure that these modules are included in their programme of study.

Students considering a transfer to the MMath in Mathematics should be aware that if, in exceptional circumstances, an MMath student does not satisfy the criteria for the award of the MMath, then the student may be eligible for the award of a BSc (Hons) degree in Mathematics. This would be subject to the satisfactory completion of the module U08699 Mathematics Project, which is compulsory for the BSc (Hons) in Mathematics. If the student is unable to complete the module U08699 Mathematics Project, they would be eligible for a BSc ordinary degree in Mathematics.

**2.2 Aim/s of the programme**

The principal aim of this course is to provide an education in the mathematical sciences to produce graduates who are equipped with the necessary range of skills and depth of understanding to successfully pursue careers in a wide range of numerate and analytic professions. Students completing the course will have an understanding of the foundations, techniques, limitations and applications of selected areas of mathematics and statistics, together with the confidence to tackle mathematical problems and to formulate and analyse mathematical and numerical models with applications in the applied sciences. They will be able to demonstrate an enhanced ability to communicate within and across discipline boundaries, and to work both independently and as a member of a team. To accomplish this the programme will specifically aim to:

1) provide a broad education in the mathematical sciences from which a career in mathematics, statistics with specialist knowledge in applied pathways through related subject applications;
2) promote the use of mathematical sciences as a means of expression and for problem solving in a range of application areas;
3) develop logical, analytical and problem solving abilities, and foster transferable skills in communication and information technology;
4) encourage students to develop a critical and independent approach to their learning;
5) provide a foundation for further academic study as independent learners, research training and future career development.
6) Allow students to develop practical skills in the applied sciences laboratories or develop management skills for application in the workplace.

## SECTION 3: PROGRAMME LEARNING OUTCOMES

**On successful completion of the programme, graduates will demonstrate the following Brookes Attributes:**

### *3.1 Academic literacy*

3.1.1 Knowledge and understanding of a range of methods and techniques in mathematics and statistics.
3.1.2 Knowledge and understanding of the fundamentals of algebra, linear algebra, calculus and analysis.
3.1.3 Knowledge and understanding of applying mathematical techniques arising in mathematical contexts, and statistical techniques arising in statistical contexts, to include a selection from: discrete mathematics, differential equations, geometry, numerical analysis, applied algebra, quantitative research methods, time series analysis, communicating statistics and sampling and surveys.
3.1.4 The ability to construct logical mathematical arguments, including those requiring mathematical proof.
3.1.5 The ability to interpret and work with problems formulated in mathematical form.
3.1.6 Knowledge and understanding of mathematical modelling techniques
3.1.7 Knowledge and understanding of key concepts of probability theory and statistics.
3.1.8 The ability to use and apply selected statistical methods.

### *3.2 Research literacy*

3.2.1 An ability to learn independently and apply that skill in order to extend the subject knowledge base or apply acquired knowledge to novel situations in a variety of analytic contexts.

### *3.3 Critical self-awareness and personal literacy*

3.3.1 The ability to select and apply mathematical problem solving techniques and experience in analysing and evaluating these.
3.3.2 The ability to express themselves clearly, concisely and correctly using mathematical language
3.3.3 A critical and independent approach to learning.
3.3.4 Effective self-management and the ability to work in a team.

### *3.4 Digital and information literacy*

3.4.1 The ability to use and apply professional mathematical and statistical software.
3.4.2 Effective use of digital technology to present analysis and solutions to a variety of audiences

### *3.5 Active citizenship*

3.5.1 An ability to effectively communicate information derived from mathematical and statistical analysis to a global audience.

## SECTION 4: PROGRAMME STRUCTURE AND CURRICULUM

### 4.1 Programme structure and requirements:

The programme comprises the following modules:

| **LEVEL: 4** | | | | |
|---|---|---|---|---|
| **Module Code** | **Module Title** | **Credits** | **Status** | **Semester of delivery** |
| U08408 | Probability Theory | 15 | Compulsory | 1 |

| | | | | |
|---|---|---|---|---|
| U08409 | Statistical Inference | 15 | Compulsory | 2 |
| U08603 | Algebra & Calculus (double) | 30 | Compulsory | 1 & 2 |
| U08601 | Mathematical Skills and Modelling | 30 | Compulsory | 1 & 2 |
| U08609 | Introductory Mathematics | 15 | Recommended | 1 |
| U08400 | Basic Survey Methods | 15 | Recommended | 2 |
| U08700 | Word-processing & Spreadsheet IT Skills | 15 | Recommended | 1 or 2 |
| U08606 | Discrete Mathematics | 15 | Recommended | 2 |

| **LEVEL: 5** | | | | |
|---|---|---|---|---|
| **Module Code** | **Module Title** | **Credits** | **Status** | **Semester of delivery** |
| U08625 | Linear Algebra and Analysis | 30 | Compulsory | 1 & 2 |
| U08626 | Graph Theory | 15 | Alternative Compulsory (1) | 1 |
| U08629 | Further Discrete Mathematics | 15 | Alternative Compulsory (1) (4) | 1 |
| U08631 | Numerical Analysis I | 15 | Alternative Compulsory (1) (4) | 2 |
| U08424 | Quantitative Research Methods | 15 | Alternative Compulsory (2) (4) | 1 |
| U08423 | Time Series Analysis | 15 | Alternative Compulsory (2) (4) | 1 |
| U08440 | Simulation & Modelling | 15 | Acceptable (4) | 1 |
| U08624 | Complex Analysis | 15 | Acceptable | 2 |
| U08420 | Mathematical Statistics | 15 | Acceptable (4) | 2 |
| U08623 | Applied Abstract Algebra | 15 | Acceptable (4) | 2 |
| U08627 | Mathematical Models | 30 | Acceptable (4) | 1 & 2 |
| U50038 | Mathematics for Decision Making | 15 | Acceptable (5) | 1 |
| **Optional Sandwich Year** | | | | |
| **Module Code** | **Module Title** | **Credits** | **Status** | **Semester of delivery** |
| U04665 | Industrial Placement Year | 0 | Compulsory for sandwich mode students | 1, 2 & 3 |

| **LEVEL: 6** | | | | |
|---|---|---|---|---|
| **Module Code** | **Module Title** | **Credits** | **Status** | **Semester of delivery** |
| U08699 | Mathematics Project | 30 | Compulsory | 1 or 2 |
| U08687 | Honours Topics in Mathematics | 30 | Alternative Compulsory (3) | 1 & 2 |
| U08671 | Ordinary and Partial Differential Equations | 30 | Alternative Compulsory (3) | 1 & 2 |
| U08481 | Regression Models | 15 | Acceptable (4) | 2 |
| U08483 | Medical Statistics | 15 | Acceptable (4) | 2 |
| U08680 | Geometry | 15 | Acceptable | 2 |
| U08682 | Numerical Analysis II | 15 | Acceptable | 1 |
| U08672 | Topology | 15 | Acceptable | 1 |
| U08688 | Independent Study in Mathematics | 15 | Acceptable | 1 or 2 |

(1): At least one of these modules must be included
(2): At least one of these modules must be included
(3): At least one of these modules must be included
(4): Note that these modules have a different status for the MMath in Mathematics. Students considering a transfer to the MMath programme should refer to the Programme Specification for the MMath in Mathematics for details.
(5): Note this module is not acceptable for the MMath in Mathematics. Students considering a transfer to the MMath programme should not take this module.

Progression from first year to second year requires students, in addition to modular programme regulations, to pass all compulsory modules.

To obtain the BSc (Hons) in Mathematical Sciences, students must pass within eight years the equivalent of at least 24 modules (360 credits) including at least eight level 4 modules (120 credits) and at least sixteen acceptable level 5 and 6 modules (240 credits) of which at least six (90 credits) must be at level 6. Students must pass the following modules:

| Module Code | Module Title | Credits | Level | Status | Semester of delivery |
|---|---|---|---|---|---|
| **Year 1 – 120 credits at level 4** | | | | | |
| U08408 | Probability Theory | 15 | 4 | Compulsory | 1 |
| U08409 | Statistical Inference | 15 | 4 | Compulsory | 2 |
| U08603 | Algebra & Calculus | 30 | 4 | Compulsory | 1 & 2 |
| U08601 | Mathematical Skills and Modelling | 30 | 4 | Compulsory | 1 & 2 |
| Plus a further 30 credits at level 4 | | | | | |
| **Years 2 and 3 – 240 credits at levels 5 and 6, to include at least 90 credits at level 6** | | | | | |
| U08625 | Linear Algebra and Analysis | 30 | 5 | Compulsory | 1 & 2 |
| U08699 | Mathematics Project | 30 | 6 | Compulsory | 1 & 2 |
| Plus at least 15 credits from: | | | | | |
| U08629 | Further Discrete Mathematics | 15 | 5 | Alternative Compulsory | 1 |
| U08626 | Graph Theory | 15 | 5 | Alternative Compulsory | 1 |
| U08631 | Numerical Analysis I | 15 | 5 | Alternative Compulsory | 2 |
| Plus at least 15 credits from: | | | | | |
| U08424 | Quantitative Research Methods | 15 | 5 | Alternative Compulsory | 1 |
| U08423 | Time Series Analysis | 15 | 5 | Alternative Compulsory | 1 |
| Plus at least 30 credits from: | | | | | |
| U08687 | Honours Topics in Mathematics | 30 | 6 | Alternative Compulsory | 1 & 2 |
| U08671 | Ordinary and Partial Differential Equations | 30 | 6 | Alternative Compulsory | 1 & 2 |
| Plus a selection from the following modules: | | | | | |
| U08623 | Applied Abstract Algebra | 15 | 5 | Acceptable | 1 |
| U08624 | Complex Analysis | 15 | 5 | Acceptable | 2 |
| U08682 | Numerical Analysis II | 15 | 6 | Acceptable | 1 |
| U08672 | Topology | 15 | 6 | Acceptable | 1 |
| U08680 | Geometry | 15 | 6 | Acceptable | 2 |
| U08627 | Mathematical Models | 30 | 5 | Acceptable | 1 & 2 |
| U08688 | Independent Study in Mathematics | 15 | 6 | Acceptable | 1 or 2 |
| U50038 | Mathematics for Decision Making | 15 | 5 | Acceptable | 2 |
| U08440 | Simulation and Modelling | 15 | 5 | Acceptable | 1 |
| U08420 | Mathematical Statistics | 15 | 5 | Acceptable | 2 |
| U08481 | Regression Models | 15 | 6 | Acceptable | 2 |
| U08483 | Medical Statistics | 15 | 6 | Acceptable | 2 |

To obtain the BSc in Mathematical Sciences, students must pass within eight years the equivalent of at least 20 modules (300 credits) including at least eight level 4 modules (120 credits) and at least twelve acceptable level 5 and 6 modules (180 credits). Students must pass the following modules:

| Module Code | Module Title | Credits | Level | Status | Semester of delivery |
|---|---|---|---|---|---|
| **Year 1 – 120 credits at level 4** | | | | | |
| U08408 | Probability Theory | 15 | 4 | Compulsory | 1 |
| U08409 | Statistical Inference | 15 | 4 | Compulsory | 2 |
| U08603 | Algebra & Calculus | 30 | 4 | Compulsory | 1 & 2 |
| U08601 | Mathematical Skills and Modelling | 30 | 4 | Compulsory | 1 & 2 |
| Plus a further 30 credits at level 4 | | | | | |
| **Years 2 and 3 – 180 credits at levels 5 and 6** | | | | | |
| U08625 | Linear Algebra and Analysis | 30 | 5 | Compulsory | 1 & 2 |
| Plus at least 15 credits from: | | | | | |
| U08629 | Further Discrete Mathematics | 15 | 5 | Alternative Compulsory | 1 |
| U08626 | Graph Theory | 15 | 5 | Alternative Compulsory | 1 |
| U08631 | Numerical Analysis I | 15 | 5 | Alternative Compulsory | 2 |
| Plus at least 15 credits from: | | | | | |
| U08424 | Quantitative Research Methods | 15 | 5 | Alternative Compulsory | 1 |
| U08423 | Time Series Analysis | 15 | 5 | Alternative Compulsory | 1 |
| Plus a selection from the following modules: | | | | | |
| U08623 | Applied Abstract Algebra | 15 | 5 | Acceptable | 1 |
| U08624 | Complex Analysis | 15 | 5 | Acceptable | 2 |
| U08682 | Numerical Analysis II | 15 | 6 | Acceptable | 1 |
| U08672 | Topology | 15 | 6 | Acceptable | 1 |
| U08680 | Geometry | 15 | 6 | Acceptable | 2 |
| U08627 | Mathematical Models | 30 | 5 | Acceptable | 1 & 2 |
| U08688 | Independent Study in Mathematics | 15 | 6 | Acceptable | 1 or 2 |
| U08687 | Honours Topics in Mathematics | 30 | 6 | Acceptable | 1 & 2 |
| U08671 | Ordinary and Partial Differential Equations | 30 | 6 | Acceptable | 1 & 2 |
| U50038 | Mathematics for Decision Making | 15 | 5 | Acceptable | 2 |
| U08699 | Mathematics Project | 30 | 6 | Acceptable | 1 & 2 |
| U08440 | Simulation and Modelling | 15 | 5 | Acceptable | 1 |
| U08420 | Mathematical Statistics | 15 | 5 | Acceptable | 2 |
| U08481 | Regression Models | 15 | 6 | Acceptable | 2 |
| U08483 | Medical Statistics | 15 | 6 | Acceptable | 2 |

To obtain the DipHE in Mathematical Sciences, students must pass within six years the equivalent of at least 16 modules (240 credits) including at least eight level 4 modules (120 credits) and at least eight acceptable level 5 and 6 modules (120 credits). Students must pass the following modules:

| Module Code | Module Title | Credits | Level | Status | Semester of delivery |
|---|---|---|---|---|---|
| **Year 1 – 120 credits at level 4** | | | | | |
| U08408 | Probability Theory | 15 | 4 | Compulsory | 1 |
| U08409 | Statistical Inference | 15 | 4 | Compulsory | 2 |
| U08603 | Algebra & Calculus | 30 | 4 | Compulsory | 1 & 2 |
| U08601 | Mathematical Skills and Modelling | 30 | 4 | Compulsory | 1 & 2 |
| Plus a further 30 credits at level 4 | | | | | |
| **Years 2 and 3 – 120 credits at levels 5 and 6** | | | | | |
| U08625 | Linear Algebra and Analysis | 30 | 5 | Compulsory | 1 & 2 |
| Plus at least 15 credits from: | | | | | |
| U08629 | Further Discrete Mathematics | 15 | 5 | Alternative Compulsory | 1 |
| U08626 | Graph Theory | 15 | 5 | Alternative Compulsory | 1 |
| U08631 | Numerical Analysis I | 15 | 5 | Alternative Compulsory | 2 |
| Plus at least 15 credits from: | | | | | |
| U08424 | Quantitative Research Methods | 15 | 5 | Alternative Compulsory | 1 |
| U08423 | Time Series Analysis | 15 | 5 | Alternative Compulsory | 1 |
| Plus a selection from the following modules: | | | | | |
| U08623 | Applied Abstract Algebra | 15 | 5 | Acceptable | 1 |
| U08624 | Complex Analysis | 15 | 5 | Acceptable | 2 |
| U08682 | Numerical Analysis II | 15 | 6 | Acceptable | 1 |
| U08672 | Topology | 15 | 6 | Acceptable | 1 |
| U08680 | Geometry | 15 | 6 | Acceptable | 2 |
| U08627 | Mathematical Models | 30 | 5 | Acceptable | 1 & 2 |
| U08688 | Independent Study in Mathematics | 15 | 6 | Acceptable | 1 or 2 |
| U08687 | Honours Topics in Mathematics | 30 | 6 | Acceptable | 1 & 2 |
| U08671 | Ordinary and Partial Differential Equations | 30 | 6 | Acceptable | 1 & 2 |
| U50038 | Mathematics for Decision Making | 15 | 5 | Acceptable | 2 |
| U08699 | Mathematics Project | 30 | 6 | Acceptable | 1 & 2 |
| U08440 | Simulation and Modelling | 15 | 5 | Acceptable | 1 |
| U08420 | Mathematical Statistics | 15 | 5 | Acceptable | 2 |
| U08481 | Regression Models | 15 | 6 | Acceptable | 2 |
| U08483 | Medical Statistics | 15 | 6 | Acceptable | 2 |

### 4.2 Professional requirements

None

## SECTION 5: PROGRAMME DELIVERY

### 5.1 Teaching, Learning and Assessment

Mathematics is provided within the Department of Mechanical Engineering and Mathematical Sciences. The Mathematical Sciences course was designed with three fundamental goals for teaching and learning:

(a) to ensure that the learning process, knowledge and assessment requirements placed on students continues to be transparent, achievable and of high quality
(b) to equip students with appropriate professional and transferable skills, giving them 'added value'
(c) to teach, practise and develop the skills students require to undertake research.

These are developed with reference to national guidelines such as the QAA subject benchmarking document for Mathematics, Statistics and Operational Research. In this vein every effort is made to integrate subject material and show its use, effect and application across the course following the University's Assessment Compact. The descriptions that follow are general and should not be seen as exclusive.

**Contact time and student effort**

Students typically study eight 15 credit modules per year, divided over two semesters. Timetabled teaching usually consists of 24 hours of lectures and 12 hours of practical classes, supplemented by a further 114 hours on guided self study for each 15 credit module. For a 30 credit module, students can expect these times to be doubled.

Self study typically consists of solving tutorial problems, reading or group meetings. The strategy for assessment of the learning outcomes is described in each module syllabus. Student engagement with assessment and feedback processes is achieved through such mechanisms as meetings with the programme team, a student forum, Department policy for timely feedback to allow reflection on assessment and learning, and end of module evaluation. The assessment strategy is guided by the "Brookes Assessment Compact" and details may be found at:
http://www.brookes.ac.uk/aske/documents/BrookesAssessmentCompact09.pdf

Module leaders choose a division between examination and coursework that suits the subject and the module learning outcomes. All assessment is designed to be aligned with module learning outcomes and the combination of learning outcomes and individual modules combine to provide the graduate attributes for the subject. There are currently four main strategies for assessment in the programme:

- 80% exam & 20% coursework
- 70% exam & 30% coursework
- 50% exam & 50% coursework
- 100% coursework

Typically examinations last for two hours. Coursework assignments are wide ranging and invariably challenging making use of strategies such as:

1. Poster presentations and oral presentations;
2. Reports, Essays and other Descriptive Explanation;

3. Problem sheets;
4. Class tests.

The provision of a coursework calendar prevents the bunching of deadlines, whilst student involvement in programme meetings helps to ensure that they have input to the development of assessment policy implemented in the programme. The virtual learning environment is used extensively to provide a wide variety of teaching materials and assessment methods with both formative and summative feedback. The virtual learning environment also makes learning resources, peer group support and interaction available outside normal working hours.

For all modules, in addition to the overall 40% pass mark, students are normally required to gain at least 30% of the available coursework mark and at least 30% of the available examination mark.

**Achieving the Graduate Attributes**

Graduate attributes are mapped to learning outcomes in groups of modules as follows:

**Academic literacy**

As a discipline, mathematics is cumulative in nature, and as such the acquisition of new skills in unfamiliar branches of the subject is heavily reliant on well developed prerequisite knowledge. The construction of logical mathematical arguments is a key competence developed in mathematics modules at all levels and requires the synthesis of new and familiar concepts in the subject. All modules in mathematics and statistics require the use of mathematical methods and problem solving techniques, where information expressed in mathematical form has to be analysed, manipulated, simplified and interpreted.

The programme includes a progression through a spine of compulsory pure mathematics modules, namely U08603 Algebra and Calculus level 4, U08625 Linear Algebra and Analysis at level 5, and either U08687 Honours Topics in Mathematics or U08671 Ordinary and Partial Differential Equations at level 6. The module U08603 Algebra and Calculus develops the foundations of algebra and calculus and includes some introductory material on linear algebra and mathematical proof. This provides the foundation work needed for a formal treatment of linear algebra and analysis in U08625 Linear Algebra and Analysis. These two modules develop the advanced level prerequisite knowledge required for the study of honours level mathematics modules, and in particular for U08687 Honours Topics in Mathematics, U08671 Ordinary and Partial Differential Equations and U08699 Mathematics Project.

Programmes must include the compulsory module U08601 Mathematical Skills and Modelling, which both applies and extends key concepts from A-level and subsequent mathematical study. Programmes will also include a selection of areas of mathematics from: discrete mathematics (U08626 Graph Theory, U08629 Further Discrete Mathematics), differential equations (U08603 Algebra and Calculus, U08671 Ordinary and Partial Differential Equations), numerical analysis (U08631 Numerical Analysis I, U08682 Numerical Analysis II), geometry and topology (U08680 Geometry, U08672 Topology), applied algebra (U08623 Applied Abstract Algebra). Proof techniques are introduced in U08603 Algebra and Calculus and applied extensively in U08625 Linear Algebra and Analysis. These techniques find further application in other modules at level 5 (e.g. U08626 Graph Theory, U08629 Further Discrete Mathematics, U08623 Applied Abstract Algebra) and level 6 (U08680 Geometry, U08672 Topology). Mathematical modelling forms an integral part of the basic module U08601 Mathematical Skills and Modelling and also arises in the optional level 5 module U08627 Mathematical Models and in the alternative compulsory level 6 module U08687 Honours Topics in Mathematics.

Statistical knowledge is developed initially through the compulsory basic modules U08408 Probability Theory and U08409 Statistical Inference. Foundation work on probability theory and distributions is

covered in U08408 Probability Theory. This is applied to random samples in U08409 Statistical Inference, where estimation and testing are also included. These modules provide the necessary background knowledge for a study of statistics at advanced level. All programmes will incorporate some modules in statistics at advanced level in which further experience of applying statistical methods will be acquired. These will include a selection of areas of statistics from: quantitative research methods (U08424 Quantitative Research Methods), time series analysis (U08423 Time Series Analysis), mathematical statistics (U08420 Mathematical Statistics), regression analysis (U08481 Regression Models) and medical statistics (U08483 Medical Statistics). Programmes may vary considerably in the volume of their statistical content.

**Research literacy**

Research literacy is a constant theme that appears again and again throughout the programme, from writing reports on mathematical models developed in the first year to more extended pieces of library research in U08424 Quantitative Research Methods, U08687 Honours Topics in Mathematics and the project module U08690 Mathematics Project. In these modules, students apply skills and research literacies gained in earlier modules to enable them to plan an original piece of work and carry out the necessary research to familiarise themselves with current work in the area.

**Critical self-awareness and personal literacy**

This Graduate Attribute is addressed in a number of modules. Confidence in selecting and applying mathematical problem solving techniques is developed from the start of the course, with applications of mathematics being introduced in the first semester in U08609 Introductory Mathematics and featuring in modules such as U08626 Graph Theory and U08623 Applied Abstract Algebra. Teamwork is an integral part of many modules, from modelling tasks in U08601 Mathematical Skills and Modelling and survey design in U08400 Basic Survey Methods to group work in U08424 Quantitative Research Methods and U08440 Simulation and Modelling. Discipline specific communication skills are developed throughout the course where mathematical arguments and statistical analyses are presented, discussed, evaluated and applied, as the solution or analysis of a problem, or a report on a topic in mathematics or statistics. In the level 5 module U08627 Mathematical Models, this includes writing a short paper. Oral communication is developed throughout the course via the discussion of problems and results. In addition more formal oral presentations arise in several mathematics modules e.g. in selected topics from the level 6 modules U08687 Honours Topics in Mathematics, U08671 Ordinary and Partial Differential Equations and the project module U08690 Mathematics Project.

**Digital information literacy**

Graduates of the programme necessarily have very well developed computer based analytical skills because of the large amount of computer software used throughout the course. Mathematical software is introduced in U08601 Mathematical Skills and Modelling and is also used as a tool to assist with the analysis of problems in other modules at level 5 (e.g. U08631 Numerical Analysis I) and level 6 (e.g. U08682 Numerical Analysis II, U08687 Honours Topics in Mathematics). Statistical software is first introduced in the basic module U08408 Probability Theory and is also used in U08409 Statistical Inference and level 5 and 6 modules in statistics.

However, the Graduate Attribute ‘Digital information literacy’ extends beyond this to include the use of computers for more general skills such as presentations, literature reviews, preparation of reports, and so on.

The application of software to model physical objects and components U08601 Mathematical Skills and Modelling and in U08627 Mathematical Models gives graduates from this programme a significant advantage in the employment market and their applied skills in this literacy is highly valued by many companies.

**Active citizenship**

This Graduate Attribute relates to how well the graduates of the programme are prepared to work in the wider business context. The modern treatment of the mathematical sciences relies heavily on the use of established symbolic notation and as such the subject has become an international language which is practised and used world-wide.

The current staff is comprised of a diverse group of individuals from several continents, who have experience of teaching in the UK and elsewhere, both in English and in other languages. To their teaching, the members of this group necessarily bring both cultural diversity and knowledge of the subject curricula in other countries. This is further enhanced by the experiences of researchers in the group who are involved in international collaborations and participate at international conferences.

The group has active exchange links, through the Erasmus Programme, with the University of Malta and the Pedagogische Hochschule Karlsruhe. Students studying Mathematical Sciences have the opportunity to undertake exchanges and there are international students on all courses. All of these activities contribute towards enhancing the international flavour of the community of learners and teachers working together during modules. Practical classes take place in all modules and provide students with an opportunity to work on structured exercises with assistance from lecturers. This classroom environment enables home and international students to work together, to collectively engage in detailed discussions of mathematical and statistical problems and to share their ideas, experience and knowledge of the subject. Further dialogue of this nature takes place in groupwork activities (e.g. in U08430, U08440 and U08604) and through the discussion of problems outside class and in surgeries. All of these activities facilitate and encourage cross cultural communication to take place during modules within the programme.

### 5.2 Assessment regulations

The programme conforms to the University Regulations for the undergraduate modular programme

## SECTION 6: ADMISSIONS

### 6.1 Entry criteria

Students entering year 1 of the courses will normally be at least 18 years of age and hold one of the following qualifications:

(i) A-levels (typically a minimum of ABC grades) in three subjects with a grade A in Mathematics
(ii) International Baccalaureate Diploma (typically a minimum of 30 points with at least 5 in Higher Mathematics)
(iii) BTEC National Diploma (typically with one distinction and two merits) PLUS A2-level Mathematics (typically at grade A minimum)

A minimum grade C at GCSE English Language is expected.

Credit entry into the second or third year of the programme may be possible for students who have accrued appropriate mathematical credits.

Entry to the combined honours degree in Mathematical Sciences is also possible via the Foundation Year in Engineering (FEG) and Foundation Year in Computing (FCO) offered by the Faculty of

Technology, Design and Environment. This option is normally recommended to those prospective students whose entry qualifications do not match the levels outlined in the above paragraph.

**English Language Requirements**

For details of the University's English Language requirements see: http://www.brookes.ac.uk/international/apply/english/.

In particular, students for whom English is not their first language are required to have IELTS 6.0 (with 6.0 in reading and writing, 5.5 in listening and speaking).

### 6.2 DBS checks

A DBS check is not necessary for entry to this course but may be required to fulfil criteria for entry to some work based learning opportunities.

## SECTION 7: STUDENT SUPPORT AND GUIDANCE

For many years, the Department has provided new students (including direct entry) with a detailed induction programme in the first week of Semester 1. This is now followed on by the Open Seminar Series. Students often feel there is an 'overload' and too much to 'take-in' in Week 1 so the Open Seminar Series provides an opportunity to embed University learning approaches and styles. It should also be remembered that many students, particularly overseas students, miss out on Week 1 activities due to arriving late at the University. Upon arrival at the University all students are allocated an Academic Advisor and have access to Student Support Co-ordinators for general academic and pastoral advice, respectively.

In practical terms, support for student achievement is given in a variety of ways, namely a timetable of tutorials and workshops, practical classes to support material covered in formal lectures as well as the 'surgeries' described earlier.

The Department is supportive of students with registered disabilities and special needs and works closely with Student Support Co-ordinators who liaise closely with students, staff involved with their learning and teaching, and the University's Student Services who operationalise the University's disability policies. These mechanisms allow for enhanced learning opportunities from this group of students. For example, online resources on various disabilities are available to staff via the University's intranet. Support for disabled students is provided centrally and staff can liaise directly with these services regarding individual students. The University provides a wide variety of services such as for example, the dyslexia support, note takers, sign language interpreters and more general support workers for students with mobility difficulties as well as special examination provision. During the review period, the department has taught, assisted and supported many students with a wide variety of disabilities. These include students with dyslexia, dyspraxia, visual impairment, epilepsy, audio impairment, mobility and muscular disabilities. Examples of the support given include providing materials in alternative forms and ensuring that room locations are appropriate for wheelchair users. The symbolic nature of Mathematics means that successful note taking is assisted considerably by having some appreciation of how Mathematics should look on the page. In the past, it has sometimes been found challenging to recruit support workers to act as note takers or amanuenses. In such cases academic staff have been contacted by central staff and have become involved to try and find solutions where needed.

This support provision is common to all undergraduate programmes within the Department, and since the MMath is an undergraduate programme it is appropriate that the same support is available to MMath students.

Careers sessions are organised for all students on Mathematics programmes, and guidance is also provided by the Faculty's Placements Officer. Students on the MMath course will be able to take a placement year after their second year. The Placements Officer posts details of vacancies on the Department's placements page on Moodle, although students are also able to find their own placement if they would prefer. Students are responsible for obtaining a placement position, and no guarantees of placement availability are made by the Department.

## SECTION 8: GRADUATE EMPLOYABILITY

Students graduating from this course are able to follow an extensive range of career opportunities. Examples of successful employment are:

Actuary, AON
Transport Planner
Trainee Estimator, Amey Infrastructure Services Ltd.
Graduate Engineer
Graduate Support Analyst, HFC
Market Research Analyst, A C Neilsen
Accountant, Capital

## SECTION 9: LINKS WITH EMPLOYERS

The Department has extensive links with local employers and the Faculty has even broader professional links with businesses in every sector of the economy. Currently graduates in Mathematics follow widely varying career paths in a very diverse range of professions but it is a strategic objective to build stronger links with companies to allow students with an interest in applied mathematics to participate in a placement year to grow and improve the existing reputation of the Department.

## SECTION 10: QUALITY MANAGEMENT

**Indicators of quality/methods for evaluating the quality of provision**

Our robust quality management practices include:

- Rigorous admission procedures
- Feedback from students in the annual module evaluations
- Annual evaluations of the programme by External Examiners
- Annual Programme Reviews
- Five yearly Periodic Reviews
- Subject Committees and Subject Away Days
- Student Representative System

The programme also conforms to the structure and regulations of the University's Undergraduate Framework. The course is subject to the University quality assurance procedures.