

Programme Specification: Undergraduate

For students starting in Academic Year 2020/21

1. Course Summary

Names of programme and award title(s)	Master in Mathematics (MMath) Master in Mathematics with International Year (see Annex for details) Master in Mathematics with Work Placement Year (see Annex for details)
Award type	Single Honours (Masters)
Mode of study	Full-time
Framework of Higher Education Qualification (FHEQ) level of final award	Level 7
Normal length of the programme	4 years; 5 years with either the International Year or Placement Year between years 2 and 3
Maximum period of registration	The normal length as specified above plus 3 years
Location of study	Keele Campus
Accreditation (if applicable)	All three programmes are accredited by the Institute of Mathematics and its Applications (IMA)
Regulator	Office for Students (OfS)
Tuition Fees	<p>UK/EU students:</p> <p>Fee for 2020/21 is £9,250*</p> <p>International students:</p> <p>Fee for 2020/21 is £14,750**</p> <p>The fee for the international year abroad is calculated at 15% of the standard year fee</p> <p>The fee for the work placement year is calculated at 20% of the standard year fee</p>

Please note this document applies to Level 5 students only in 2021/22. Level 4, 6 and 7 students should refer instead to the documents labelled '2021/22', '2019/20 Entry' or '2018/19', respectively.

How this information might change: Please read the important information at <http://www.keele.ac.uk/student-agreement/>. This explains how and why we may need to make changes to the information provided in this document and to help you understand how we will communicate with you if this happens.

* These fees are regulated by Government. We reserve the right to increase fees in subsequent years of study in response to changes in government policy and/or changes to the law. If permitted by such change in policy or law, we may increase your fees by an inflationary amount or such other measure as required by government policy or the law. Please refer to the accompanying Student Terms & Conditions. Further information on fees can be found at <http://www.keele.ac.uk/studentfunding/tuitionfees/>

** We reserve the right to increase fees in subsequent years of study by an inflationary amount. Please refer to the accompanying Student Terms & Conditions for full details. Further information on fees can be found at <http://www.keele.ac.uk/studentfunding/tuitionfees/>

2. What is an Integrated Masters programme?

Integrated master's awards - which are common in science, mathematics and engineering - are delivered through a programme that combines study at the level of a bachelor's degree with honours with study at Master's level. As such, a student graduates with a master's degree after a single four-year programme of study. The Integrated Masters programme described in this document builds upon the three year Single Honours programme by adding a fourth year in which students study modules in Mathematics at an advanced level.

In keeping with Keele's commitment to breadth in the curriculum, the programme also gives students the opportunity to take some modules outside Mathematics, in other disciplines and in modern foreign languages as part of a 480-credit Honours degree. Thus it enables students to gain, and be able to demonstrate, a distinctive range of graduate attributes.

3. Overview of the Programme

Mathematics is a traditional discipline with a very long history. The Programme provides a broad coverage of the three main discipline areas of pure mathematics, applied mathematics and statistics. Pure mathematics is concerned with mathematical proof (the derivation of results), logical argument and abstraction. Applied mathematics is concerned with methods and their application to modelling real-world problems. Statistics concerns mathematical modelling of uncertainty and the analysis of data. The Programme has been designed to give maximum flexibility with many options in the final year, which allows students to pick options within their broad field of interest and to study topics to some depth. In addition to subject-specific skills, the Programme also provides students with generic and employability skills.

4. Aims of the programme

The broad aims of the programme are to enable you to:

- provide you with knowledge, understanding and skills relevant to discrete and continuous mathematics, including logical argument, rigorous mathematical proof, problem solving and mathematical modelling;
- provide you with knowledge, understanding and skills relevant to statistical theory, methods of data investigation, the formulation and analysis of probability-based models in order to make inferences from samples, and applications of statistics and operational research;
- further develop your interest in mathematics within a caring and intellectually stimulating environment
- cultivate your appreciation of the beauty, elegance and practicality of mathematics;
- produce skilled and motivated graduates who are suitably prepared for further study or for employment within or outside their field;
- equip you with a range of generic and employability skills particularly in any area where precise, logical thought and problem-solving skills are valued;
- provide a foundation for life-long learning, study and enquiry in mathematics.

Further, and in accordance with the Quality Assurance Agency (QAA) 2015 Mathematics, Statistics and Operational Research (MSOR) benchmark statement for MMath programmes, a graduate who completes this Programme should, in addition to reaching the level for a bachelor's degree, be able to:

- demonstrate understanding of the main body of knowledge of the Programme, providing a basis for originality in developing and/or applying ideas, sometimes within a research context, and should extend and enhance the understanding associated with achievement at bachelor's level;
- apply knowledge and problem-solving abilities in new or unfamiliar environments;
- integrate knowledge and handle complexity, and formulate judgements with incomplete or limited information, where appropriate reflecting on social or ethical responsibilities linked to the application of that knowledge or those judgements;
- communicate conclusions and the knowledge and rationale underpinning these, to specialist and non-specialist audiences, clearly and unambiguously;
- demonstrate the ability to work professionally with a considerable degree of independence;
- continue to study in a manner that may be largely self-directed or autonomous.

5. What you will learn

The intended learning outcomes of the programme (what students should know, understand and be able to do at the end of the programme), can be described under the following headings:

- Subject knowledge and understanding
- Subject specific skills
- Intellectual skills

Subject knowledge and understanding

Successful students will be able to demonstrate knowledge and understanding of:

U1 appropriate mathematical methods and techniques in the areas of calculus, algebra, differential equations, vector calculus, complex

variable, abstract algebra, and probability

U2 the use of mathematical notation

U3 the role of precise and logical argument and deductive reasoning, including the formal process of mathematical proof

U4 the use of structured mathematical and analytical approaches to problem solving

U5 the science of data investigation and visualisation, and the application of statistics

U6 probability-based models, hypothesis testing, statistical inference and likelihood

U7 the power of generalisation and abstraction

U8 the application of mathematical modelling techniques to the solution of real-world problems

U9 symbolic manipulation packages and mathematical word-processing tools

In addition to the above, a graduate who has reached the typical level for MMath should further be able to:

M1 demonstrate understanding of the main body of knowledge of the programme, which should extend and enhance the understanding associated with achievement at the Bachelor's level;

M2 apply knowledge and problem-solving abilities in new or unfamiliar environments and within broader contexts;

M3 integrate knowledge and handle complexity, and formulate judgements with incomplete or limited information;

M4 communicate conclusions and the knowledge and rationale underpinning these, to specialist and non-specialist audiences, clearly and unambiguously;

M5 demonstrate the ability to work professionally and with a considerable degree of independence, and continue to study in a self-directed and autonomous manner.

Subject specific skills

S1 demonstrate knowledge of key mathematical and statistical concepts, both explicitly and by applying them to the solution of mathematical problems

S2 comprehend problems, abstract their essential components and formulate them in symbolic terms so as to facilitate their analysis and solution, understanding how mathematical and/or statistical processes may be applied to them

S3 select and apply appropriate mathematical and/or statistical techniques

S4 use mathematical models to analyse a problem and to interpret the results of the analysis

S5 understand the importance of assumptions made in mathematical and statistical models, be aware of when and where they are used and the possible consequences of their violation

S6 construct and develop logical mathematical arguments with clear identification of assumptions and conclusions

S7 reason critically, carefully and logically and derive (prove) mathematical results

S8 demonstrate facility with mathematical abstraction

S9 demonstrate skills designing observational studies, analysing data resulting from them, and formulating and testing hypotheses

S10 use symbolic mathematical software packages, statistical packages and mathematical typesetting software

S11 research and write up a topic in the style of an academic journal article

Intellectual skills

Successful students will be able to:

G1 analyse and solve problems, thinking carefully and logically and making reasoned decisions

G2 persist with the solution to a problem until its successful conclusion

G3 make critical interpretations of data and text, and develop reasoned arguments

G4 take responsibility for their own learning and reflect upon that learning

G5 develop and sustain effective approaches to learning, including time-management, organisation, flexibility, creativity and intellectual integrity

G6 acquire, analyse, synthesise, summarise and present information and ideas from a range of sources and to communicate this effectively and coherently by written and spoken means

G7 be adaptable, in particular to display a readiness to address new problems in new areas

G8 work independently or with others to achieve an objective

G9 motivate themselves and sustain that motivation over an extended period of time

Keele Graduate attributes

Engagement with this programme will enable you to develop your intellectual, personal and professional capabilities. At Keele, we call these our ten Graduate Attributes and they include independent thinking, synthesizing information, creative problem solving, communicating clearly, and appreciating the social, environmental and global implications of your studies and activities. Our educational programme and learning environment is designed to help you to become a well-rounded graduate who is capable of making a positive and valued contribution in a complex and rapidly changing world, whichever spheres of life you engage in after your studies are completed.

Further information about the Keele Graduate Attributes can be found here: <http://www.keele.ac.uk/journey/>

6. How is the programme taught?

Learning and teaching methods used on the programme vary according to the subject matter and level of the module. They include the following:

- **Traditional lectures** where the lecturer provides students with detailed notes, very often backed up by pre-prepared notes, together with references to text books, as is the norm in the discipline
- **Tutorial Classes** that are more informal than the lectures and provide the class tutor with the opportunity to revise and enforce core ideas and to provide students with more worked examples. It is also often the opportunity for students to try problems themselves and to discuss solutions with their peers, under the supervision of the tutor, who provides immediate feedback
- **Practical sessions** in the computer laboratories, in which students use the PCs interactively and are provided with feedback by the computer and the tutor
- **Independent study** based on processing lecture notes and reading text books, together with attempting regular coursework assignments
- **Web-based learning** using the University's virtual learning environment (KLE). The KLE is used to give students easy access to a wide range of resources, and as a platform for online discussions
- The opportunity to undertake a piece of independent study supervised and supported by a member of staff

Apart from these formal activities, students are also provided with regular opportunities to talk through particular areas of difficulty, and any special learning needs they may have, with their Personal Tutors or module lecturers on a one-to-one basis.

These learning and teaching methods enable students to achieve the learning outcomes of the programme in a variety of ways. For example:

- Lectures and independent study allow students to gain knowledge and understanding of the three broad areas of mathematics.
- Tutorial Classes provide opportunities for students to ask questions about, and suggest answers to mathematical problems, and to present their own ideas to members of staff and other students using an appropriate medium of communication.
- Independent study, in particular, the regular coursework assignments, encourages students to reflect on their own learning and take responsibility for its development by addressing areas of difficulty, perhaps by discussing them with their fellow students or by getting additional help from a member of staff.
- Undertaking a project with the support of an experienced researcher allows students to formulate relevant research questions and devise a feasible strategy to answer them.

7. Teaching Staff

The Mathematics academic staff comprises of a number of Professors, Senior Lecturers, Lecturers and Teaching Fellows. Most members of staff are active in research. A number of members of the Mathematics Division hold teaching qualifications. Currently, several staff members are Fellows of the Higher Education Academy.

The University will attempt to minimise changes to our core teaching teams, however, delivery of the programme depends on having a sufficient number of staff with the relevant expertise to ensure that the programme is taught to the appropriate academic standard.

Staff turnover, for example where key members of staff leave, fall ill or go on research leave, may result in changes to the programme's content. The University will endeavour to ensure that any impact on students is limited if such changes occur.

8. What is the structure of the Programme?

The academic year runs from September to June and is divided into two semesters. The number of weeks of teaching will vary from course to course, but you can generally expect to attend scheduled teaching sessions between the end of September and mid-December, and from mid-January to the end of April. Our degree courses are organised into modules. Each module is usually a self-contained unit of study and each is usually assessed separately with the award of credits on the basis of 1 credit = 10 hours of student effort. An outline of the structure of the programme is provided in the tables below.

There are three types of module delivered as part of your programme. They are:

- Compulsory modules - a module that you are required to study on this course;
- Optional modules - these allow you some limited choice of what to study from a list of modules;
- Elective modules - a free choice of modules that count towards the overall credit requirement but not the number of subject-related credits.

A summary of the credit requirements per year is as follows, with a minimum of 105 subject credits (compulsory plus optional) required at Levels 4,5,6 and 120 subject credits required at Levels 7.

For further information on the content of modules currently offered, including the list of elective modules, please visit:

<https://www.keele.ac.uk/recordsandexams/modulecatalogue/>

Year	Compulsory	Optional		Electives	
		Min	Max	Min	Max
Level 4	105	0	15	0	15
Level 5	105	0	15	0	15
Level 6	0	105	120	0	15
Level 7	60	60	60	0	0

Module Lists

Level 4

Compulsory modules	Module Code	Credits	Period
Mathematical Methods	MAT-10043	15	Semester 1
Calculus	MAT-10046	30	Semester 1-2
Algebra	MAT-10047	30	Semester 1-2
Investigations and Problem Solving	MAT-10049	30	Semester 1-2

Optional modules	Module Code	Credits	Period
Applied Mathematics	MAT-10051	15	Semester 2
Statistics	MAT-10053	15	Semester 2

Level 5

Compulsory modules	Module Code	Credits	Period
Differential Equations	MAT-20008	15	Semester 1
Probability	MAT-20023	15	Semester 1
Computational Mathematics	MAT-20031	15	Semester 1
Exploring Algebra and Analysis	MAT-20035	15	Semester 1
Complex Variable I and Vector Calculus	MAT-20004	15	Semester 2
Abstract Algebra	MAT-20025	15	Semester 2
Professional Mathematics and Data Science	MAT-20037	15	Semester 2

Optional modules	Module Code	Credits	Period
Dynamics	MAT-20005	15	Semester 2
Linear Statistical Models	MAT-20027	15	Semester 2
Analysis II	MAT-20029	15	Semester 2

International Year - Students choosing the international year take the 120 credit compulsory module 'MAT-20030 International Study Module'. This is a Level 5 module.

Work Placement Year - Students choosing the placement year take the non-credit bearing compulsory module 'MAT-30035 Work Placement Year'. This is a Level 6 module.

Level 6

Optional modules	Module Code	Credits	Period
Graph Theory	MAT-30001	15	Semester 1
Non-linear Differential Equations	MAT-30002	15	Semester 1
Partial Differential Equations	MAT-30003	15	Semester 1
Group Theory	MAT-30013	15	Semester 1
Number Theory and Cryptography	MAT-30038	15	Semester 1
Financial Mathematics	MAT-30039	15	Semester 1
Project II - ISP	MAT-30016	15	Semester 1-2
Project (30 credits)	MAT-30043	30	Semester 1-2
Fluid Mechanics	MAT-30004	15	Semester 2
Complex Variable II	MAT-30010	15	Semester 2
Waves	MAT-30011	15	Semester 2
Medical Statistics	MAT-30014	15	Semester 2
Mathematical Biology	MAT-30023	15	Semester 2
Introduction to Mathematics Teaching	MAT-30034	15	Semester 2
Linear Algebra and Rings	MAT-30045	15	Semester 2
Introduction to Linear Elasticity	MAT-30047	15	Semester 2
Mathematical Modelling	MAT-30051	15	Semester 2

Level 7

Compulsory modules	Module Code	Credits	Period
Masters Project	MAT-40003	60	Semester 1-2

Optional modules	Module Code	Credits	Period
Hydrodynamic Stability Theory	MAT-40004	20	Semester 1-2
Linear Elasticity	MAT-40005	20	Semester 1-2
Combinatorial Designs	MAT-40007	20	Semester 1-2
Continuum Mechanics	MAT-40012	20	Semester 1-2
Perturbation Methods	MAT-40013	20	Semester 1-2
Numerical Modelling with Partial Differential Equations	MAT-40014	20	Semester 1-2
Field and Galois Theory	MAT-40016	20	Semester 1-2
Topics in Group Theory	MAT-40018	20	Semester 1-2

Learning Outcomes

The table below sets out what students learn in the programme and the modules in which that learning takes place. Details of how learning outcomes are assessed through these modules can be found in module specifications.

Subject Knowledge and Understanding	
Learning Outcome	Module in which this is delivered
U1 - appropriate mathematical methods and techniques in the areas of calculus, algebra, differential equations, vector calculus, complex variable, abstract algebra, and probability.	All Level 4 and Level 5 compulsory modules together with a selection of optional modules at all levels.
U2 - the use of mathematical notation.	All modules
U3 - the role of precise and logical argument and deductive reasoning, including the formal process of mathematical proof.	Algebra, Complex Variable and Vector Calculus, Abstract Algebra, Probability, Level 6 and Level 7 optional modules.
U4 - the use of structured mathematical and analytical approaches to problem solving.	All modules but, in particular, Investigations and Problem Solving, Applied Mathematics, Professional Mathematics.
U5 - the science of data investigation and visualisation, and the application of statistics.	Statistics, Probability, Linear Statistical Models, Medical Statistics, Financial Mathematics. Level 6 and 7 Project.
U6 - probability-based models, hypothesis testing, statistical inference and likelihood.	Statistics, Probability, Medical Statistics, Linear Statistical Models, Financial Mathematics. Level 6 and Level 7 Project.
U7 - the power of generalisation and abstraction.	Exploring Algebra and Analysis, Abstract Algebra, Group Theory, Number Theory and Cryptography, Graph Theory, Linear Algebra and Rings, Field and Galois Theory, Topics in Group Theory Level 6 and Level 7 Project.
U8 - the application of mathematical modelling techniques to the solution of real-world problems.	Investigations and Problem Solving, Applied Mathematics, Dynamics, Level 6 and Level 7 optional, applied mathematics modules. Level 6 and Level 7 Project.
U9 - symbolic manipulation packages and mathematical word-processing tools.	Investigations and Problem Solving, Applied Mathematics, Differential Equations, Computational Mathematics, Medical Statistics, Financial Mathematics, Professional Mathematics. Level 6 and Level 7 Project.
M1 - demonstrate understanding of the main body of knowledge of the programme, which should extend and enhance the understanding associated with achievement at the Bachelor's level.	All Level 7 modules
M2 - apply knowledge and problem-solving abilities in new or unfamiliar environments and within broader contexts.	All Level 7 modules
M3 - integrate knowledge and handle complexity, and formulate judgements with incomplete or limited information.	All Level 7 modules
M4 - communicate conclusions and the knowledge and rationale underpinning these, to specialist and non-specialist audiences, clearly and unambiguously.	Level 7 Masters Project
M5 - demonstrate the ability to work professionally and with a considerable degree of independence, and continue to study in a self-directed and autonomous manner.	All Level 7 modules

Subject Specific Skills	
Learning Outcome	Module in which this is delivered
S1 - demonstrate knowledge of key mathematical and statistical concepts, both explicitly and by applying them to the solution of mathematical problems.	All modules
S2 - comprehend problems, abstract their essential components and formulate them in symbolic terms so as to facilitate their analysis and solution, understanding how mathematical and/or statistical processes may be applied to them.	Investigations and Problem Solving, Applied Mathematics, Differential Equations, Dynamics, Number Theory and Cryptography, Level 6 and Level 7 applied mathematics modules. Level 6 and Level 7 Project.
S3 - select and apply appropriate mathematical and/or statistical techniques.	All modules
S4 - use mathematical models to analyse a problem and to interpret the results of the analysis.	Investigations and Problem Solving, Applied Mathematics, Differential Equations, Dynamics, Number Theory and Cryptography, Level 6 and Level 7 applied mathematics modules. Level 6 and Level 7 Project
S5 - understand the importance of assumptions made in mathematical and statistical models, be aware of when and where they are used and the possible consequences of their violation.	Investigations and Problem Solving, Applied Mathematics, Differential Equations, Dynamics, Number Theory and Cryptography, Level 6 and Level 7 applied mathematics modules. Level 6 and Level 7 Project.
S6 - construct and develop logical mathematical arguments with clear identification of assumptions and conclusions.	All modules
S7 - reason critically, carefully and logically and derive (prove) mathematical results.	Calculus, Algebra, Abstract Algebra, Exploring Algebra and Analysis, Probability, Analysis II, Complex Variable and Vector Calculus, Level 6 and Level 7 pure mathematics modules. Level 6 and Level 7 Project.
S8 - demonstrate facility with mathematical abstraction.	Exploring Algebra and Analysis, Abstract Algebra, Graph Theory, Group Theory, Number Theory and Cryptography, Linear Algebra and Rings, Field and Galois Theory, Topics in Group Theory, Level 6 and 7 Projects.
S9 - demonstrate skills designing observational studies, analysing data resulting from them, and formulating and testing hypotheses.	Investigations and Problem Solving, Applied Mathematics, Medical Statistics, Financial Mathematics, Professional Mathematics, Level 6 and Level 7 applied mathematics modules. Level 6 and Level 7 Project.
S10 - use symbolic mathematical software packages, statistical packages and mathematical typesetting software.	Investigations and Problem Solving, Applied Mathematics, Differential Equations, Computational Mathematics, Medical Statistics, Professional Mathematics. Level 6 and Level 7 Project
S11 - research and write up a topic in the style of an academic journal article.	Level 7 Project

Intellectual skills	
Learning Outcome	Module in which this is delivered
G1 - analyse and solve problems, thinking carefully and logically and making reasoned decisions.	All modules
G2 - persist with the solution to a problem until its successful conclusion.	All modules
G3 - make critical interpretations of data and text, and develop reasoned arguments.	All modules
G4 - take responsibility for their own learning and reflect upon that learning.	All modules but, in particular, Investigations and Problem Solving, Applied Mathematics, Professional Mathematics. Level 6 and Level 7 Projects
G5 - develop and sustain effective approaches to learning, including time-management, organisation, flexibility, creativity and intellectual integrity.	All modules
G6 - acquire, analyse, synthesise, summarise and present information and ideas from a range of sources and to communicate this effectively and coherently by written and spoken means.	All modules, but in particular Level 6 and Level 7 Projects
G7 - be adaptable, in particular, to display a readiness to address new problems in new areas.	Level 6 and Level 7 modules, but in particular the Level 6 and Level 7 Projects
G8 - work independently or with others to achieve an objective.	All modules
G9 - motivate themselves and sustain that motivation over an extended period of time.	All modules, in particular the Level 6 and Level 7 Projects

9. Final and intermediate awards

Credits required for each level of academic award are as follows:

Master in Mathematics Degree	480 credits	You will require at least 120 credits at levels 4, 5, 6 and 7 You must accumulate at least 435 credits in Mathematics (out of 480 credits overall), with at least 105 credits in each of Years 1, 2 and 3 (Levels 4, 5 and 6) and 120 in Year 4 (Level 7) in Mathematics modules. NB: students transferring to the MMath programme from the Mathematics combined honours programme will require only 330 credits in Mathematics modules, with 105 credits coming from Level 6 modules and 120 credits from Level 7 modules.
Honours Degree	360 credits	You will require at least 120 credits at levels 4, 5 and 6
Diploma in Higher Education	240 credits	You will require at least 120 credits at level 4 or higher and at least 120 credits at level 5 or higher
Certificate in Higher Education	120 credits	You will require at least 120 credits at level 4 or higher

Master in Mathematics with International Year: in addition to the above students must pass a module covering the international year

in order to graduate with a named degree in Mathematics with international year. Students who do not complete, or fail the international year, will be transferred to the four-year Master in Mathematics programme.

Mathematics with Work Placement Year: in addition to the above students must pass MAT-30035, the non-credit bearing module covering the work placement year, in order to graduate with the 'with work placement year' version of the Honours degree. Students who do not complete or fail the work placement year will be transferred to the four-year mathematics programme. Failure of the work placement year will be recorded on a student's final transcript.

10. How is the Programme Assessed?

The wide variety of assessment methods used on this programme at Keele reflects the broad range of knowledge and skills that are developed as you progress through the degree programme. Teaching staff pay particular attention to specifying clear assessment criteria and providing timely, regular and constructive feedback that helps to clarify things you did not understand and helps you to improve your performance. The following list is representative of the variety of assessment methods used on your programme:

- **Unseen examinations:** test a student's knowledge and understanding of mathematics. They are the usual, primary mode of assessment in mathematics programmes across the HE sector. Such examinations are of two hours in length and all questions are compulsory. Many modules in Levels 4 to 7 have unseen examinations as part of the assessment profile.
- **Class tests:** these are taken during the course of a module, usually in a lecture slot. They are intended to assess a student's current understanding and subject knowledge in that module in a structured and focused manner. Many taught modules in Levels 4 to 6 have class tests as part of the assessment profile.
- **Coursework:** normally consists of regular short assignments designed to assess, in more depth than class tests, a student's knowledge and understanding of the course material. Some of these assignments may be computer-based and some may take the form of short reports.
- **Short reports:** for which students are required to write up their own account of small group studies and discussions on particular topics.
- **Project Reports:** are formal summaries of the work done by a student undertaking a project. Where the project is the review of an area of mathematics the report tests the student's ability to evaluate the material and identify and summarise the key points. Statistics projects often involve the analysis of real-world data and the report will test the student's ability to make critical judgements concerning the appropriateness of different strategies for the collection and analysis of such data. For projects involving mathematical modelling the report tests the student's ability to construct appropriate models, make realistic simplifying assumptions, and use the model effectively to analyse the problem.
- **Video presentations:** where students produce an informative video presentation suitable for a general audience which explains their project, its purpose and the outcomes. These videos are presented to the class and can be live, animated, or a combination of both.
- **Oral presentations:** assess a student's ability to communicate their knowledge and understanding, both visually and orally, to both general and academic audiences.

Marks are awarded for summative assessments designed to assess your achievement of learning outcomes. You will also be assessed formatively to enable you to monitor your own progress and to assist staff in identifying and addressing any specific learning needs. Feedback, including guidance on how you can improve the quality of your work, is also provided on all summative assessments within three working weeks of submission, unless there are compelling circumstances that make this impossible, and more informally in the course of tutorial and seminar discussions.

11. Contact Time and Expected Workload

This contact time measure is intended to provide you with an indication of the type of activity you are likely to undertake during this programme. The data is compiled based on module choices and learning patterns of students on similar programmes in previous years. Every effort is made to ensure this data is a realistic representation of what you are likely to experience, but changes to programmes, teaching methods and assessment methods mean this data is representative and not specific.

Undergraduate courses at Keele contain an element of module choice; therefore, individual students will experience a different mix of contact time and assessment types dependent upon their own individual choice of modules. The figures below are an example of activities that a student may expect on your chosen course by year stage of study. Contact time includes scheduled activities such as: lecture, seminar, tutorial, project supervision, demonstration, practical classes and labs, supervised time in labs/workshop, fieldwork and external visits. The figures are based on 1,200 hours of student effort each year for full-time students.

Activity

	Scheduled learning and teaching activities	Guided independent Study	Placements
Year 1 (Level 4)	31%	69%	0%
Year 2 (Level 5)	30%	70%	0%
Year 3 (Level 6)	21%	79%	0%
Year 4 (Level 7)	15%	85%	0%

12. Accreditation

All three programmes are accredited by the Institute of Mathematics and its Applications (IMA). The institute's accreditation states that this award meets the educational requirements of Chartered Mathematician designation.

13. University Regulations

The University Regulations form the framework for learning, teaching and assessment and other aspects of the student experience. Further information about the University Regulations can be found at: <http://www.keele.ac.uk/student-agreement/>

If this programme has any exemptions, variations or additions to the University Regulations these will be detailed in an Annex at the end of this document titled 'Programme-specific regulations'.

14. What are the typical admission requirements for the Programme?

See the relevant course page on the website for the admission requirements relevant to this programme:

<https://www.keele.ac.uk/study/>

Applicants who are not currently undertaking any formal study or who have been out of formal education for more than 3 years and are not qualified to A-level or BTEC standard may be offered entry to the University's Foundation Year Programme.

Applicants for whom English is not a first language must provide evidence of a recognised qualification in English language. The minimum score for entry to the Programme is Academic IELTS 6.0 or equivalent.

Please note: All non-native English speaking students are required to undertake a diagnostic English language assessment on arrival at Keele, to determine whether English language support may help them succeed with their studies. An English language module may be compulsory for some students during their first year at Keele.

Recognition of Prior Learning (RPL) is considered on a case-by-case basis and those interested should contact the Programme Director. The University's guidelines on this can be found here: <http://www.keele.ac.uk/ga/accreditationofpriorlearning/>

15. How are students supported on the programme?

Support for student learning on the Programme is provided in the following ways:

- Module lecturers and Examples Class tutors are responsible for providing support for learning on the modules. They also give individual feedback on coursework assignments and more general feedback on examinations. The Mathematics Division has an Open Door policy so that lecturers and tutors are happy to see and advise students at any reasonable time, or by a mutually convenient appointment.
- The Mathematics Learning and Technology Officer provides help and advice to students concerning work on the computers in the laboratory.
- Every student is allocated to a Personal Tutor who is responsible for reviewing and advising on students' academic progress in Mathematics and on their other Principal Programme.
- Personal Tutors also act as a first point of contact for students on non-academic issues which may affect their learning and can refer students on to a range of specialist health, welfare and financial services co-ordinated by the University's Student Services.

16. Learning Resources

Mathematics is taught, primarily, in lecture theatres equipped with whiteboards and screens for use with either visualisers or PC tablets. The majority of modules provide partial or full lecture notes in paper or electronic form (or both). There is a computer laboratory within Mathematics and, in addition, as part of the School of Computing and Mathematics, students have access to the large computer science laboratory. There is also a room reserved exclusively for private study.

The learning resources available to students on the Programme include:

- the extensive collection of books and journals relevant to undergraduate study held in the University library (much of this material is also accessible online);
- detailed printed notes and other paper resources supplied in certain modules;

- the Keele Learning Environment (KLE) which provides easy access to a range of learning resources including lecture notes, examples with solutions, past examination papers, module details and reading lists, and guidance notes for project work.

17. Other Learning Opportunities

Study Abroad (International Year)

A summary of the International Year, which is a potential option for students after completion of year 2 (Level 5), is provided in the Annex for the International Year.

Work Placement Year

A summary of the Work Placement Year, which is a potential option for students after completion of year 2 (Level 5), is provided in a separate Annex.

18. Additional Costs

As to be expected there will be additional costs for inter-library loans and potential overdue library fines, print and graduation. We do not anticipate any further costs for this undergraduate programme.

19. Quality management and enhancement

The quality and standards of learning in this programme are subject to a continuous process of monitoring, review and enhancement.

- The School Education Committee is responsible for reviewing and monitoring quality management and enhancement procedures and activities across the School.
- Individual modules and the programme as a whole are reviewed and enhanced every year in the annual programme review which takes place at the end of the academic year.
- The programmes are run in accordance with the University's Quality Assurance procedures and are subject to periodic reviews under the Internal Quality Audit (IQA) process.

Student evaluation of, and feedback on, the quality of learning on every module takes place every year using a variety of different methods:

- The results of student evaluations of all modules are reported to module leaders and reviewed by the Programme Committee as part of annual programme review.
- Findings related to the programme from the annual National Student Survey (NSS), and from regular surveys of the student experience conducted by the University, are subjected to careful analysis and a planned response at programme and School level.
- Feedback received from representatives of students in all three years of the programme is considered and acted on at regular meetings of the Student Staff Voice Committee.

The University appoints senior members of academic staff from other universities to act as external examiners on all programmes. They are responsible for:

- Approving examination questions
- Confirming all marks which contribute to a student's degree
- Reviewing and giving advice on the structure and content of the programme and assessment procedures

Information about current external examiner(s) can be found here:

<http://www.keele.ac.uk/qa/externalexaminers/currentexternalexaminers/>

20. The principles of programme design

The programme described in this document has been drawn up with reference to, and in accordance with the guidance set out in, the following documents:

- UK Quality Code for Higher Education, Quality Assurance Agency for Higher Education: <http://www.qaa.ac.uk/quality-code>
- QAA Subject Benchmark Statement: Mathematics, Statistics and Operational Research (2015) <https://www.qaa.ac.uk/quality-code/subject-benchmark-statements?indexCatalogue=document-search&searchQuery=mathematics&wordsMode=AllWords>
- Keele University Regulations and Guidance for Students and Staff: <http://www.keele.ac.uk/regulations>
- Keele University Placement Learning Code of Practice: <https://www.keele.ac.uk/policyzone/viewbyowner/studentandacademicservices/name,117421,en.php>

21. Annex - International Year

Master in Mathematics with International Year

International Year Programme

Students registered for Master in Mathematics may either be admitted for or apply to transfer during their period of study at Level 5 to the 'Master in Mathematics with International Year'. Students accepted onto this programme will have an extra year of study (the International Year) at an international partner institution after they have completed Year 2 (Level 5) at Keele.

Students who successfully complete both the second year (Level 5) and the International Year will be permitted to progress to Level 6. Students who fail to satisfy the examiners in respect of the International Year will normally revert to the Master in Mathematics course and progress to Level 6 on that basis. The failure will be recorded on the student's final transcript.

Study at Level 4, Level 5, Level 6 and Level 7 will be as per the main body of this document. The additional detail contained in this annex will pertain solely to students registered for 'Master in Mathematics with International Year'.

International Year Programme Aims

In addition to the programme aims specified in the main body of this document, the international year programme of study aims to provide students with:

1. Personal development as a student and a researcher with an appreciation of the international dimension of their subject
2. Experience of a different culture, academically, professionally and socially

Entry Requirements for the International Year

Students may apply to the 5-year programme during Level 5. Admission to the International Year is subject to successful application, interview and references from appropriate staff.

The criteria to be applied are:

- Academic Performance (an average of 60% across all modules in Semester 1 at Level 5 is normally required. Places on the International Year are then conditional on achieving an average mark of 54% across all Level 5 modules with no module fails. Where no Semester 1 marks have been awarded performance in 1st year marks and ongoing 2nd year assessments are taken into account)
- General Aptitude (to be demonstrated by application for study abroad, interview during the 2nd semester of year 2 (Level 5), and by recommendation of the student's personal tutor, 1st and 2nd year tutors and programme director)

Any failed Level 5 modules without good cause will result in the student being prohibited from transferring to the 5-year Master in Mathematics with International Year programme.

Students may not register for both an International Year and a Placement Year.

Student Support

Students will be supported whilst on the International Year via the following methods:

- Phone or Skype conversations with Study Abroad tutor, in line with recommended Personal Tutoring meeting points.
- Support from the University's Global Education Team

Learning Outcomes

In addition to the learning outcomes specified in the main text of the Programme Specification, students who complete a Keele undergraduate programme with International Year will be able to:

1. Describe, discuss and reflect upon the cultural and international differences and similarities of different learning environments
2. Discuss the benefits and challenges of global citizenship and internationalisation
3. Explain how their perspective on their academic discipline has been influenced by locating it within an international setting
4. be able to communicate effectively in an international setting
5. be able to reflect on previous learning within an international context.

These learning outcomes will all be assessed by the submission of a satisfactory individual learning agreement, the successful completion of assessments at the partner institution and the submission of the reflective portfolio element of the international year module.

Regulations

Students registered for the International Year are subject to the programme-specific regulations (if any) and the University regulations. In addition, during the International Year, the following regulations will apply:

Students undertaking the International Year must complete 120 credits, which must comprise *at least two thirds* mathematics topics.

This may impact on your choice of modules to study, for example you will have to choose certain modules to ensure you have the discipline specific credits required.

Students are barred from studying any module with significant overlap to the Level 6 modules they will study on their return. Significant overlap with Level 5 modules previously studied should also be avoided.

Additional costs for the International Year

Tuition fees for students on the International Year will be charged at 15% of the annual tuition fees for that year of study, as set out in Section 1. The International Year can be included in your Student Finance allocation, to find out more about your personal eligibility see: www.gov.uk

Students will have to bear the costs of travelling to and from their destination university, accommodation, food and personal costs. Depending on the destination they are studying at additional costs may include visas, study permits, residence permits, and compulsory health checks. Students should expect the total costs of studying abroad be greater than if they study in the UK, information is made available from the Global Education Team throughout the process, as costs will vary depending on destination.

Students studying in Erasmus+ destinations may be eligible for grants as part of this programme. Students studying outside of this programme may be eligible income dependent bursaries at Keele.

Students travel on a comprehensive Keele University insurance plan, for which there are currently no additional charges. Some Governments and/or universities require additional compulsory health coverage plans; costs for this will be advised during the application process.

22. Annex - Work Placement Year

Master in Mathematics with Work Placement Year

Work Placement Year summary

Students have the opportunity to apply directly for the 5-year with Work Placement Year degree programme or to transfer onto the 5-year degree programme at the end of Year-1 and in Year-2 at the end of Semester 1. Students accepted onto this programme will have an extra year (the Placement Year) with a relevant placement provider after they have completed Year 2 (Level 5) at Keele. Students wishing to transfer onto this programme should discuss this with student support, the academic tutor for the work placement year, and the Programme Director.

To proceed to the Placement Year, students must normally achieve an average of 55% across all Level 4 and 5 modules and undergo an interview with the Programme Director or the Academic Tutor for the Work Placement Year. If students do not meet these requirements they will revert back to the Single Honours Mathematics Programme.

Students who successfully complete both the second year (Level 5) and the Placement Year will be permitted to progress to Level 6. Students who fail to satisfactorily complete the Placement Year will normally revert to the BSc (Hons) Mathematics programme and progress to Level 6 on that basis. The failure will be recorded on the student's final transcript.

Study at Level 4, Level 5, Level 6 and Level 7 will be as per the main body of this document. The additional detail contained in this annex will pertain solely to students registered for the MMath (Hons) Mathematics with Work Placement Year.

Work Placement Year Programme Aims

In addition to the programme aims specified in the main body of this document, the Work Placement Year aims to provide students with:

1. Substantial experience of work with a relevant placement provider, including familiarisation with the professional working environment;
2. enable you to apply academic theory learned as part of your taught degree to real situations in the work place, and to expand your employability skills.

Entry Requirements for the Work Placement Year

Admission to the Placement Year is subject to successful application, interview and references from appropriate staff. Students have the opportunity to apply directly for the 5-year 'with work placement' degree programme, or to transfer onto the 5-year degree programme at the end of Year 1 (Level 4) and in Year 2 (Level 5) at the end of Semester 1. Students who are initially registered for the 5-year degree programme may transfer onto the 4-year degree programme at any point in time, prior to undertaking the year-long work placement. Students who fail to pass the work placement year, and those who fail to meet the minimum requirements of the work placement year module (minimum 30 weeks full-time (1050 hours), or equivalent, work placement), will automatically transfer onto the 4-year degree programme.

The criteria to be applied are:

- A good University attendance record and be in 'good academic standing'.
- Passed all Year-1 and Year-2 Semester 1 modules with an overall module average of 55% or higher.
- General Aptitude (to be demonstrated by the application(s) to relevant placement providers with prior agreement from the Programme Director or the Academic Tutor for the Work Placement Year, interview during the 2nd semester of Year 2 (Level 5), and by recommendation of the student's personal tutor and as necessary, other staff members).
- Students undertaking work placements will be expected to complete a Health and Safety checklist prior to commencing their work experience and will be required to satisfy the Health and Safety regulations of the company or organisation at which they are based.
- Students must have met the progression requirements to proceed to their final year of study prior to commencing a work placement. Failure to complete reassessment work in the summer reassessment period due to a work placement position will not be classed as exceptional circumstances.
- (*International students only*) Due to visa requirements, it is not possible for international students who require a Tier 4 Visa to apply for direct entry onto the 5-year with Work Placement Year degree programme. Students wishing to transfer onto this programme should discuss this with student support, the academic tutor for the work placement year, and the Programme Lead. Students should be aware that there are visa implications for this transfer, and it is the student's responsibility to complete any and all necessary processes to be eligible for this programme. There may be additional costs, including applying for a new Visa from outside of the UK for international students associated with a transfer to the work placement programme.

Students may not register for both an International Year and a Work Placement Year.

Student Support

Students will be supported whilst on the Work Placement Year via the following methods:

- Regular contact between the student and a named member of staff who will be assigned to the student as their University supervisor. The University supervisor will be in regular contact with the student throughout the year, and be on hand to provide advice (pastoral or academic) and liaise with the Placement supervisor on the student's behalf if required.
- Two formal contacts with the student during the placement year: the University supervisor will visit the student in their placement organisation at around the 5 weeks after placement has commenced, and then visit again (or conduct a telephone/video call tutorial) at around 15 weeks into the placement.
- Weekly supervision sessions will take place with the placement supervisor (or his/her nominee) throughout the duration of the placement.

Learning Outcomes

In addition to the learning outcomes specified in the main text of the Programme Specification, students who complete the 'with Work Placement Year' option will be able to:

1. evaluate their own employability skills (via a SWOT analysis);
2. create Intended Learning Outcomes for their placement in order to develop the skills areas which they have identified as needing further enhancement;
3. develop, through practice in the work place, the work-related skills identified through their SWOT analysis and Intended Learning Outcomes;
4. apply academic theory learned as part of their taught degree to real situations in the work place;
5. reflect on their work placement activities and evaluate their impact on their own employability skills;
6. explain how the sector of the placement operates and identify the skills required to pursue careers within the sector.

These learning outcomes will be assessed through the non-credit bearing Work Placement Year module (MAT-30035) which involves:

1. the submission of a SWOT analysis and action plan and an evaluation of the student's performance based on the placement supervisor's initial report;
2. the submission of a monthly reflective diary to the University supervisor and an evaluation of the student's performance based on the placement supervisor's final report;
3. a presentation about their placement experience to an audience of other students coming off placement and those about to go out on placement. The audience is also likely to contain the University supervisor and other staff from Mathematics;

Regulations

Students registered for the 'with Work Placement Year' option are subject to programme-specific regulations (if any) and the University regulations. In addition, during the Work Placement Year, the following regulations will apply:

1. Students undertaking the Work Placement Year must successfully complete the zero-credit rated 'Work Placement Year' module (MAT-30035)
2. Students must pass Assessment 1 (mid-placement portfolio) with a mark of 40% in order to continue with their work placement and pass the Work Placement Year module. Students will not be permitted to take reassessment of this component of the module.
3. Students failing Assessment 1 at first attempt will be required to withdraw from the Work Placement Year module and will be transferred onto the 3-year degree programme.
4. Students will be permitted to take reassessment of Assessment 2 (Final Placement Portfolio) and Assessment 3 (Oral Presentation), as appropriate. Students are not permitted to repeat the Work Placement Year.

Students will be expected to behave professionally in terms of:

(i) conforming to the work practices of the organisation; and

(ii) remembering that they are representatives of the University and their actions will reflect on the School and have an impact on that organisation's willingness (or otherwise) to remain engaged with the placement.

Additional costs for the Work Placement Year

Tuition fees for students on the Work Placement Year will be charged at 20% of the annual tuition fees for that year of study, as set out in Section 1. The Work Placement Year can be included in your Student Finance allocation; to find out more about your personal eligibility see: www.gov.uk

Students will have to bear the costs of travelling to and from their placement provider, accommodation, food and personal costs. Depending on the placement provider additional costs may include parking permits, travel and transport, suitable clothing, DBS checks, and compulsory health checks.

A small stipend may be available to students from the placement provider during the placement but this will need to be explored on a placement-by-placement basis as some organisations, such as charities, may not have any extra money available. Students should budget with the assumption that their placement will be unpaid.

Eligibility for student finance will depend on the type of placement and whether it is paid or not. If it is paid, this is likely to affect student finance eligibility, however if it is voluntary and therefore unpaid, should not affect student finance eligibility. Students are required to confirm eligibility with their student finance provider.

International students who require a Tier 4 visa should check with the Immigration Compliance team prior to commencing any type of paid placement to ensure that they are not contravening their visa requirements.

23. Annex - Programme-specific regulations

Programme Regulations: Mathematics

Final Award and Award Titles	Master in Mathematics (MMath) Master in Mathematics with International Year Master in Mathematics with Work Placement Year
Intermediate Award(s)	BSc (Hons) Mathematics Diploma in Higher Education Certificate in Higher Education
Last modified	June 2019
Programme Specification	https://www.keele.ac.uk/qa/programmespecifications

The University's Academic Regulations which can be found on the Keele University website (<https://www.keele.ac.uk/regulations/>)[1] apply to and regulate the programme, other than in instances where the specific programme regulations listed below over-ride them. These programme regulations list:

- *Exemptions* which are characterised by the omission of the relevant regulation.
- *Variations* which are characterised by the replacement of part of the regulation with alternative wording.
- *Additional Requirements* which set out what additional rules that apply to students in relation to this programme.

The following **exemptions, variations** and **additional requirements** to the University regulations have been checked by Academic Services and have been approved by the Faculty Education Committee.

A) EXEMPTIONS

The clause(s) listed below describe where an exemption from the University's Academic Regulations exists:

For the whole duration of their studies, students on this Programme are exempt from the following regulations:

- **No exemptions apply.**

B) VARIATIONS

The clause(s) listed below describe where a variation from the University's Academic Regulations exists:

Variation 1: Transfer onto the MMath programme

(a) This programme varies from Regulation C6, paragraph 2.1, which states the rules governing admission onto an Integrated Masters programme. This regulation will apply to the MMath Mathematics Programme with the following exceptions to the progression requirements in section 10.1:

1. In section 10.1, disregard 10.1.(b);
2. In section 10.2 replace 'Lower Second Class' with 'Upper Second Class'.

(b) Single Honours BSc Mathematics students will be permitted to transfer onto the MMath Programme at any point up to the end the first semester of Level 6, subject to having met any relevant progression criteria and, in any event, only with the approval of the Programme Director. Combined Honours BSc Mathematics students will, subject to the same considerations, normally be permitted to transfer onto the MMath Programme within two weeks of the commencement of Level 5.

(c) MMath students will be permitted to transfer to an approved Mathematics Bachelors programme at any point up to the end of week eight of the second semester of Level 6.

Variation 2: Progression

(a) The rules governing progression from one level of study to the next are governed by the University's Regulation C6 (Section 10). This regulation can be found at the following web address: <https://www.keele.ac.uk/regulations/regulationc6/>

(b) This regulation will apply to the MMath Mathematics Programme with the following exceptions:

1. In section 10.1, disregard 10.1.(b);
2. Section 10.2 shall be amended as follows: To progress from FHEQ Level 6 to FHEQ Level 7 a student must normally at least satisfy the requirements under Regulation 1A for the award of an Honours Degree in the Upper Second Honours category.

Variation 3: Degree Award

(a) The algorithm for the award of a given degree classification can be found at the following web address: <http://www.keele.ac.uk/paa/academicadministration/degreeclassification/integratedmastersdegrees>

(b) Module Condonement is permitted on the Master in Mathematics programme. The rules governing module condonement are the subject of Section 11 of Regulation C6 and can also be found at the above web address.

(c) In addition to module condonement, Mathematics also applies module compensation at Levels 5 and 6. This allows for, in exceptional circumstance, the granting by the Mathematics Examination Board of full credits for a module in which the student has scored less than 29%.

(d) The maximum amount of condonement and compensation that can be applied can be found at the following web address: <https://www.keele.ac.uk/qa/degreeclassification/dualhonourssinglehonoursbachelordegrees/modulecompensation/>

Compensation is entirely at the discretion of the Mathematics Exam Board. At Level 5, normally the Mathematics Exam Board will not compensate 15 credits where another Level 5 15 credit module is failed between 30 and 38.

(e) Any student reverting to Honours Degree candidature under the Provisions of University Regulation C6, or 6.2(c) above, shall be awarded a Single Honours Mathematics BSc degree.

(f) For students who entered Level 4 or repeated Level 4 in full in the 2013/14 academic year or earlier, and who revert to Honours Degree candidature as in 6.8(e) above shall be awarded a Mathematics Major BSc degree.

[1] References to University Regulations in this document apply to the content of the University's Regulatory Framework as set out on the University website here <https://www.keele.ac.uk/regulations/>.

Version History

This document

Date Approved: 24 March 2021

What's Changed

Added MAT-30051 Mathematical Modelling as a Level 6 optional module.

Previous documents

Version No	Year	Owner	Date Approved	Summary of and rationale for changes
2.1	2020/21	PAUL TRUMAN	08 February 2021	Changes to Level 6 optional modules: MAT-30001 Graph Theory moved from semester 2 to semester 1. MAT-30047 Introduction to linear elasticity added.
2	2020/21	PAUL TRUMAN	08 December 2020	Minor update to Programme Specific Regulations (Variation 1): deadline for transfer from the SH programme to the MMath changed from the end of level 5 to the end of the first semester of level 6.
1	2020/21	PAUL TRUMAN	19 December 2019	
3.2	2019/20	PAUL TRUMAN		
3.1	2019/20	PAUL TRUMAN	08 February 2021	Changes to Level 6 optional modules: MAT-30001 Graph Theory moved from semester 2 to semester 1. MAT-30047 Introduction to linear elasticity added. MAT-30033 Applied Time Series Removed
3	2019/20	PAUL TRUMAN	08 December 2020	Minor update to Programme Specific Regulations (Variation 1): deadline for transfer from the SH programme to the MMath changed from the end of level 5 to the end of the first semester of level 6.
2	2019/20	SARAH ROBERTS	02 June 2020	Changes to modules with 'Mathematical Modelling' removed as a compulsory module and 'Professional Mathematics and Data Science' added as an optional module at Level 5, and optional module changes at Levels 6 and 7.
1	2019/20	PAUL TRUMAN	19 December 2019	