

Programme Specification for Integrated Masters Programme Leading to: MMath/BSc Mathematics MMath/BSc Mathematics with Placement

Applicable for all undergraduate students **starting at FHEQ Level 4** in 2021

<u>Version No.</u>	<u>Date</u>	<u>Notes – QUALITY ASSURANCE USE ONLY</u>	<u>QA</u>
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Undergraduate Programme	
1. Awarding institution	Brunel University London
2. Teaching institution(s)	Brunel University London
3. Home College / Department / Division	College of Engineering, Design and Physical Sciences/ Dept of Mathematics
4. Contributing College / Department	None
5. Programme accredited by	<p><u>Institute of Mathematics and its Applications</u></p> <p>The MMath programme is accredited to meet the educational requirements of the Chartered Mathematician designation, awarded by the Institute of Mathematics and its Applications.</p> <p>The BSc programme is accredited to meet the educational requirements of the Chartered Mathematician designation, awarded by the Institute of Mathematics and its Applications, when it is followed by subsequent training and experience in employment to obtain equivalent competencies to those specified by the Quality Assurance Agency (QAA) for taught masters degrees.</p>
6. Final award(s) and FHEQ Level of Award	MMath Mathematics (FHEQ level 7) MMath Mathematics with Placement (FHEQ level 7) BSc (Hons) Mathematics (FHEQ level 6) BSc (Hons) Mathematics with Placement (FHEQ level 6)
7. Programme title	MMath Mathematics MMath Mathematics with Placement BSc Mathematics BSc Mathematics with Placement
8. Programme type (Single honours/joint honours)	Single Honours
9. Normal length of programme for each mode of study	MMath: 48 months Full time; 60 months Thick Sandwich (with Placement) BSc: 36 months Full time; 48 months Thick Sandwich (with Placement)
10. Maximum period of registration for each mode of study	MMath: 7 years Full time; 8 years Thick Sandwich (with Placement) BSc: 6 years Full time; 7 years Thick Sandwich (with Placement)
11. Variation(s) to September start	None.
12. Modes of study	Full time; Thick Sandwich
13. Modes of delivery	Standard

14. Other/Intermediate awards and titles and FHEQ Level of Award	<p>MMath andBSc: CertHe in Mathematics (FHEQ level 4) DipHe in Mathematics (FHEQ level 5) DipHe in Mathematics with Placement (FHEQ level 5) BSc (Ord) Mathematics(FHEQ level 6) BSc (Ord) Mathematics with Placement (FHEQ level 6) BSc (Hons) Mathematics (FHEQ level 6) BSc (Hons) Mathematics with Placement (FHEQ level 6)</p> <p>MMath only: BSc (Hons) Mathematics (FHEQ level 6) BSc (Hons) Mathematics with Placement (FHEQ level 6)</p>
15. UCAS Code	<p>MMath: G100 (Full time), G101 (Thick Sandwich) BSc: G103 (Full time), G104 (Thick Sandwich)</p>
16. HECoS Code	100403
17. Route Code	<p>MMath: G100UMMMATH BSc: G100USMT2</p>
18. Relevant subject benchmark statements and other external and internal reference points used to inform programme design	<p>UK Quality Code for Higher Education QAA Subject Benchmark Statement (Mathematics, Statistics and Operational Research) Brunel 2030 Brunel Placement Learning Policy, as published under the 'Placements' section of the 'Managing Higher Education Provision with Others' page.</p>
19. Admission Requirements	<p>Details of entry requirements are provided on the University's and College website. Levels of English for non-native speakers are outlined on the University's language requirements pages.</p>
20. Other relevant information (e.g. study abroad, additional information on placements)	<p>Information about work placement (Thick Sandwich mode of study) can be found on the University web page http://www.brunel.ac.uk/services/pcc</p> <p>or on our web page http://www.brunel.ac.uk/cedps/courses/placements</p>
21. Programme regulations not specified in Senate Regulation 2. Any departure from regulations specified in Senate Regulation 2 must be stated here and approved by Senate.	<p>BSc: None: MMath: Students not achieving a weighted grade point average of 11 (corresponding to the grade B-) at Levels 4, 5 or 6 will normally not be permitted to progress on the MMath programme. If they satisfy the progression requirement, students may progress at the next level on the BSc programme. Students satisfying the progression requirements of the MMath programme may be permitted to change from the BSc programme onto the MMath programme.</p>
22. Further information about the programme:	http://www.brunel.ac.uk/cedps/mathematics

23. EDUCATIONAL AIMS OF THE PROGRAMME

These programmes aim to enhance students' mathematical thought processes and their ability to frame, consider, interpret and propose solutions to a range of both abstract and applied problems in a numerate and technically advanced way. Furthermore, students will be able to communicate these advanced technical concepts and findings in a variety of media in forms.

The BSc and MMath programmes both aim to produce graduates able to:

1. Use a range of mathematical tools to solve practical problems arising in industry, commerce and the life sciences;
2. Demonstrate advanced modelling skills relevant to mathematics applied to relevant areas;
3. Use industry standard software and techniques for modelling and solving mathematical problems;
4. Communicate their results, ability and knowledge clearly to user communities using various appropriate media;
5. Work constructively and cooperatively as part of a team;
6. Progress to employment or postgraduate study in areas requiring knowledge of one or more branches of mathematics;
7. Enjoy a wide spectrum of mathematical activities, from tackling mathematical problems for their own sake through to the exploration of the role of 'real world' applied mathematics;
8. Appreciate that the enjoyment of mathematics and the need for rigour are not mutually exclusive, even complementary.

The MMath programme aims to enhance students' mathematical thought processes and deeper knowledge beyond that of the BSc Mathematics programme, better equipping MMath graduates for further study or for employment requiring a similar level of mathematical understanding. MMath students are exposed to a deeper and broader range of more advanced mathematical theories and techniques cognate to Level 6 by means of taught MSc modules and 'directed learning' modular blocks that develop independent learning skills.

The MMath programme aims further to produce graduates able to:

1. demonstrate, in theory and in practice, a deep understanding of a range of mathematical, numerical and statistical theories and algorithms of use in finance and in other domains of application of mathematics;
2. formulate, soundly and rigorously, solutions to applied mathematical and statistical problems by identifying and implementing relevant mathematical, statistical and computational tools and techniques;
3. demonstrate advanced modelling skills and use industry standard software and techniques for solving the mathematical problems arising from the models;
4. communicate their ability and knowledge, verbally and through written documentation, and have experienced working in a team;
5. progress to employment or postgraduate study in areas requiring numeracy, in particular in applied mathematics, finance and statistics;
6. demonstrate the skills required for independent research and for life-long learning at the highest level.

24. PROGRAMME AND INTERMEDIATE LEARNING OUTCOMES

The programme provides opportunities for students to develop and demonstrate knowledge and understanding (K) cognitive (thinking) skills (C) and other skills and attributes (S) in the following areas:

Year and FHEQ level	Category (K = knowledge and understanding, C = cognitive (thinking) skills, S = other skills and attributes)	Learning Outcome	Associated Assessment Blocks Code(s)	Associated Study Blocks Code(s)	Associated Modular Blocks Code(s)
Year 1 and FHEQ Level 4					
	K	1P1. Understand and implement appropriate basic techniques across a range of mathematical topics.			All blocks
	K,C	1P2. Demonstrate knowledge and understanding of the precise language, notation and elementary tools of formal mathematics (including set theory, counting and logic).			MA1612
	K,C	1P3. Formulate and solve accurately elementary mathematical problems associated with the application of mathematics to industry and the commercial world.			MA1691 MA1664
	S	1P4. Communicate accurately and reliably scientific material in a cogent and structured fashion.			MA1691 MA1664
	C,S	1P5. Use mathematical techniques and related software to model problems, generate solutions, interpret these and perform comparative analysis where appropriate.			MA1691 MA1664
	C,S	1P6. Manipulate, visualise and interpret data correctly and report findings coherently.			MA1670
	K,S	1P7. Demonstrate knowledge, Technical and personal ability to engage in a search for a professional activity.			MA1691
Year 2 and FHEQ Level 5					
	K,C	2P1. Demonstrate knowledge and critical understanding of techniques and theories of use in mathematics, including ordinary differential equations, multivariable calculus, discrete mathematics and OR.			All blocks
	K,C	2P2. Demonstrate knowledge and critical understanding of techniques and theories of elementary stochastic models and statistical inference.			MA2670

	S	2P3. Communicate mathematics effectively in a clear and concise manner appropriate to the context and audience.			MA2690 MA2647
	S	2P4. Operate in teams in order to plan, execute, report and present mathematics and computer based projects in familiar and less familiar areas .			MA2690
	K,C	2P5. Demonstrate knowledge and critical understanding of mathematical tools leading to numerical algorithms in various areas of applications.			MA2690 MA2647
	S	2P6. Demonstrate an awareness of the requirement for continuous professional development.			MA2690
	K,S	2P7. Demonstrate knowledge and technical ability in the skills required in a professional mathematical environment.			MA2690 MA2647
	K,C	2O1. Model, formulate and analyse classical problems in various areas of applications of mathematics.			All Blocks
	C	2O2. Operate within mathematical structures with a broad range of abstract mathematical concepts.			All blocks
	K	2W1. Demonstrate knowledge and understanding of the structures, processes and business environment relevant to the work placement.			MA2555
	C	2W2. Demonstrate problem-solving skills, analytical and creative skills given real life situations.			MA2555
	C	2W3. Analyse and critically reflect on the work placement context.			MA2555
	K,S	2W4. Demonstrate numerical, technical, professional and communication skills.			MA2555
	S	2W5. Demonstrate planning and organisational skills with the ability to work in a team.			MA2555
Year 3 and FHEQ Level 6					
	K,C	3P1. (Ord) Demonstrate knowledge, sound and systematic understanding of advanced mathematical tools and their use in a range of applications.			All blocks
	C,S	3P2. Formulate, solve and report on advanced problems in a broad range of application of mathematics.			All blocks
	K,C,S	3P3. Plan, execute, evaluate and report a major project.			MA3990
	C	3P4. Critically evaluate important methods and types of algorithms in applied mathematics.			All blocks

	C,S	3P5. Able to manage their own learning and critically evaluate primary sources of mathematical theories and modelling			MA3990
	C,S	3P6. Able to communicate problems and solutions in mathematical terms appropriate to the audience as well as their own critical evaluation.			All blocks
Year 4 and FHEQ Level 7					
	K	4P1. Demonstrate knowledge and understanding of state of the art mathematical tools and their use in a wide range of applications in areas of use to applied and financial mathematics and statistics;			All blocks
	C	4P2. Demonstrate a deep understanding in a range of important areas of mathematics;			All blocks
	K,C	4P3. Identify, define, and review appropriate literature prior to conducting systematic investigations and interpreting results/theories;			MA5640 MA5691
	S	4P4. Communicate effectively in written, visual, and verbal modes and use communications and information technology effectively;			MA5640 MA5691
	C,S	4P5. Plan and manage learning and appraise outcomes of learning.			All blocks
	K	4O1. Demonstrate knowledge and understanding of the mathematics and computing tools necessary to execute the advanced project.			MA5691
Learning/teaching strategies and methods to enable learning outcomes to be achieved, including formative assessments					
<p>Teaching and learning activities consist of a mix of lectures, exercise/example classes, computer workshops and more innovative teaching methods. The Department is using dedicated small rooms and centrally controlled larger rooms, with tables for group work, both with extensive computer access and boards, to enhance the students' learning experience. In lectures concepts are introduced, definitions are stated, results (theorems in mathematics modules) and techniques are explained (often proved in mathematics modules). Practice and formative feedback are continuously provided in regular exercise/example classes and computer workshops.</p> <p>In Year 1, great care is taken to give time to students to adapt to university style of learning and studying. The teaching will occur in small classes at an intensive contact hour rate for 4 weeks, followed by whole cohort lectures. The small classes are intended to foster closer contact and monitoring from group leaders so as to help students individually to adapt to university style of learning and teaching. A variety of teaching styles will be introduced during those weeks. There will be regular homework and formative class tests. This will enable students to achieve the transition from the controlled, personalised environment they might have experienced at school to an environment where they are able to work more independently, with confidence, on material they have learned about during the contact hours, including lectures and seminars. Personal contact with staff is less frequent than at school, and so it is aimed at improving the capacity and will of students to develop alone, or in groups, work learned or done in class, with a view of eventually feeling comfortable with their own capacities of being responsible and in charge of their learning.</p>					

As they progress in Term 1 of Year 1, students will take charge of their learning. In particular they will have developed learning strategies needing shorter and less frequent contact time with teaching staff, both in their mathematics and computing activities. Practice and formative feedback will also occur during lectures and surgery sessions when appropriate. Cognitive skills are based on knowledge and understanding of mathematical and computing concepts and tools.

In the block MA1612 Fundamentals of Mathematics in Year 1, key manipulative skills will be improved as well as study skills, in conjunction with tutor contact following the Tutorial@Brunel scheme. In this block, concepts used in other blocks to develop abstract ideas will be fostered.

From Year 2, students will continue to be able to study from plenary lectures, exercises classes and computer labs. To be able to pursue their interests, students can choose most of their third (for MMath and BSc) and fourth (for MMath) year mathematical modules and modular blocks in areas covering mathematical methods, including complex variable theory, differential equations, discrete mathematics, combinatorics, applications to the physical and non physical worlds, numerical methods, operational research, probability and risk modelling, and statistics. For the 40 credit FHEQ Level 6 Project MA3990 (for MMath and BSc) and the FHEQ Level 7 Advanced Project MA5691 (for MMath only), students will be allocated from their list of preferences.

MMath students will choose their MA3990 project shortlist from a sub-list of the main list of available MA3990 titles to ensure that MA3990 projects for MMath students contain a sufficient level of any or all of pure, applied and computational mathematics. Furthermore, MMath students at FHEQ Level 7 will have five options to choose from a list drawn from the MSc course modules and 'directed learning' modules. The latter will be drawn from the broad research areas of members of staff and supported by weekly contact hours and by textbooks or equivalent. Students will polish and deepen their skills for independent learning, reflection and presentation of their achievements.

In our degrees we intend to develop seriously and explicitly professional and modelling skills across the levels. Acquiring such skills is an important part of undergraduate studies and needs space in our curriculum for students to receive feedback and improve. Although some of those skills are also imbedded in the context of all blocks, they need space and independent assessment to highlight that their acquisition is indispensable for progression in the programme.

Starting in Year 1, the block MA1691 will be dedicated to the development of programming skills and their use in small projects. The block MA1664 will start the development of professional skills, including writing and presentation, in classical modelling context appropriate to Year 1. In Year 2, the block MA 2690 will continue the development of professional skills linked to the placement and job market, via employability conferences and other sessions during the year. There will also be an improvement of general and computing skills, as well as more advanced modelling with application to Deep Learning in the block MA2647. In the BSc final year, and the MMath final two years the project modules (MA3990 and MA5691) are important vectors that show how much has been achieved in professional skills.

Summative assessment strategies and methods to enable learning outcomes to be demonstrated.

The MMath and BSc programmes each use elements of formative and summative assessment. Although both forms of assessment will be marked/graded, only the summative assessment will count for progression or the final award. Formative assessment is fundamental in the learning process. It includes class tests (both in paper and electronic format), electronic quizzes, short written exercises, in addition to exercises and their solutions done in the classroom and at home.

During the programmes a variety of assessment methods are used, although a final examination and class tests feature heavily in 'theoretical' aspects of mathematics. Different types of coursework are important in more 'applied' assessment blocks. In fact, a mix of assignment types are used for important aspects of the curriculum in order to

strengthen specific connections between theory and practice. At each level there is a component of continuous assessment to provide summative feedback before the final examinations. In particular in Year 1, there are many opportunities for formative assessment with rapid feedback, usually class tests, weekly written coursework or computer based tests. Coursework can also be used in Years 2 and 3 for students to work on more complicated examples that need computing power or cannot be addressed in a timed examination. Usually there are no options in the questions to answer in the examinations for Years 1 and 2. In Years 3 and 4, to allow for an evaluation of the depth of understanding of the students, choices of questions are usually available.

For Year 4 of the MMath programmes the assessment for the modules common with the MSc. could have some summative coursework (depending on the modular block) and a final examination. The Advanced Project will be assessed via a final report, an oral presentation from the student followed by an oral examination of the report. The assessment for the 'directed learning' modules will use a portfolio of work done during the term. This portfolio will be presented and discussed with the examiners to assess ownership and the extent of knowledge, understanding and critical appraisal of the material compared with the learning outcomes of the module.

Due to the variability of work placement, its assessment will involve the following procedure: in collaboration with an assigned placement tutor and their work-place manager or supervisor, students are expected to define a set of concrete work placement objectives which map onto the placement learning outcomes (2W1-5). They should aim to achieve their objectives by performing the role in which they are employed, and, while doing so, write a portfolio documenting their achievements towards achieving their objectives. The grading of the portfolio will be the main contributor to the mark for the placement.

25. Programme Structure, progression and award requirements

Programme structures and features: levels, assessment blocks, credit and progression and award requirements

- **Compulsory block:** one which all students registered for the award are required to take as part of their programme of study. These will be listed in the left hand column;
- **Optional block:** one which students choose from an 'option range'. These will be listed in the right hand column;
- A **core assessment** is an assessment identified within an assessment block or modular block (either compulsory or optional) which must be passed (at grade D- or better) in order to be eligible to progress and to be eligible for the final award. All core assessments must be specified on the programme specification next to the appropriate assessment or modular block:

Where students are expected to pass the block at D- or better, but not necessarily all elements, then the block itself is core.

e.g. AB3000 Project (40)

Core: Block

Where only some elements of assessments are required to be passed at D- or better, these will be identified by listing each element that is core

e.g. ABXXX1 Title (XX credits)

Core: 1 & 4

Where students are expected to pass all assessments in a block then this will be identified. By setting the assessment this way, students are also required to pass the block by default. This will be identified thus:

e.g. ABXXXX Title (XX credits)

Core: All, Block

- A **non-core assessment** does not have to be passed at grade D- or better, but must be better than a grade F, in order to progress and to be eligible for the final award.

Year 1 and FHEQ Level 4	
Compulsory assessment block codes, titles and credits	Optional assessment block codes, titles and credits
Compulsory study block codes, titles and credit volume	Optional Study block codes, titles and credit volume
Compulsory modular block codes, titles and credits All blocks are 20 credits unless otherwise stated MA1611 Calculus MA1612 Fundamentals Core: Element 1 MA1620 Linear Algebra MA1664 Elements of Applied Mathematics MA1670 Probability and Statistics I MA1691 Programming and Mathematical Projects	Optional modular block codes, titles and credits
Year 1 and FHEQ Level 4 - Progression and Award Requirements	
As per Senate Regulation 2	

Year 2 and FHEQ Level 5	
Compulsory assessment block codes, titles and credits	Optional assessment block codes, titles and credits
Compulsory study block codes, titles and credit volume	Optional Study block codes, titles and credit volume
Compulsory modular block codes, titles and credits All blocks are 20 credits unless otherwise stated MA2612 Multivariable Calculus MA2670 Probability and Statistics II MA2682 Discrete Mathematics and OR MA2690 Professional Development and Project Work MA2647 Mathematics of Deep Learning MA2632 Algebra and Analysis	Optional modular block codes, titles and credits
Year 2 and FHEQ Level 5 - Progression and Award Requirements	
As per Senate Regulation 2	

Year 2 and FHEQ Level 5 – Placement	
Compulsory assessment block codes, titles and credits	Optional assessment block codes, titles and credits
Compulsory study block codes, titles and credit volume	Optional study block codes, titles and credit volume
Compulsory modular block codes, titles and credits This modular block is a requirement only for the awards “with Placement” MA2555_CB Work Placement (120 placement credits) Core: Block	Optional modular block codes, titles and credits
Year 2 and FHEQ Level 5 Placement Progression and Award Requirements As per Senate Regulation 2 <i>For BSc Financial Mathematics, MA2555 will contribute 25% of Year 2 and FHEQ Level 5 profile and 8.33% of the overall degree calculation.</i> <i>For MMath Financial Mathematics, MA2555 will contribute 25% of Year 2 and FHEQ Level 5 profile and 5% of the overall degree calculation.</i>	

Year 3 and FHEQ Level 6	
Compulsory assessment block codes, titles and credits	Optional assessment block codes, titles and credits
Compulsory study block codes, titles and credit volume	Optional study block codes, titles and credit volume
Compulsory modular block codes, titles and credits All the modular blocks are 20 credits unless stated otherwise. MA3990 Final Year Project (40 credits) Core: Block <u>For MMath only:</u> MA3614 Complex Variable Methods and Applications	Optional modular block codes, titles and credits All the modular blocks are 20 credits unless stated otherwise. <u>Students must choose 60 credits of options from the following list:</u> MA3610 Ordinary and Partial Differential Equations MA3626 Encryption and Data Compression MA3650 Numerical Methods for Differential Equations MA3670 Statistics III MA3676 Stochastic Models MA3686 Risk and Optimisation for Financial Planning <u>For BSc only:</u> MA3614 Complex Variable Methods and Applications
Year 3 and FHEQ Level 6 Progression and Award Requirements As per Senate Regulation 2 <i>For BSc Financial Mathematics, MA2555 will contribute 8.33% of the overall degree calculation</i>	

Year 4 and FHEQ Level 7	
<p>Compulsory modular block codes, titles and credits</p> <p>MA5640 Research Methods and Case Studies (15 credits) Core: Block</p> <p>MA5691 Advanced Project (30 credits) Core: Block</p>	<p>Optional modular block codes, titles and credits</p> <p><u>Students must choose 75 credits of options from the following list:</u></p> <p>MA5614 Probability and Stochastics (15 credits)</p> <p>MA5616 Financial Computing I (15 credits)</p> <p>MA5619 Advanced Mathematical Methods (15 credits)</p> <p>MA5676 Time Series Modelling (15 credits)</p> <p>MA5620 Topics in Combinatorics (15 credits)</p> <p>MA5661 Dynamical Systems and ODEs (15 credits)</p> <p>MA5664 Mathematical Biology (15 credits)</p> <p>MA5672 Random Matrix Theory (15 credits)</p> <p>MA5663 Fundamentals of Machine Learning (15 credits)</p> <p>MA5675 Network Models (15 credits)</p> <p>MA5673 Computer Intensive Statistical Methods (15 credits)</p>
<p>Year 4 and FHEQ Level 7 Progression and Award Requirements</p> <p>As per Appendix B of Senate Regulation 2</p> <p><i>For the award of MMath Financial Mathematics, MA2555 will contribute 5% of the overall degree weighting</i></p>	

Please note: this specification provides a concise summary of the main features of the programme and the learning outcomes that a student might reasonably be expected to achieve and demonstrate if he/she takes full advantage of the learning opportunities that are provided. More detailed information on the learning outcomes, content and teaching, learning and assessment methods can be found in the modular block, assessment and study block outlines and other programme and block information. The accuracy of the information contained in this document is reviewed by the University from time to time and whenever a modification occurs.