Programme Information		
Programme Title	Programme Code	HECoS Code
Mathematics with Applied Mathematics/Mathematical Physics	G1F3	For Registry Use Only

Award	Length of Study	Mode of Study	Entry Point(s)	Total Credits	
				ECTS	CATS
BSc	3 years	Full time	Annually in October	180	360
Dip. HE*	2 years	Full time	N/A	120	240
Cert. HE*	1 year	Full time	N/A	60	120
* The Cert. HE / Dip. HE are exit awards and are not available for entry. All students must apply to and join the B.Sc.					

Ownership			
Awarding Institution	Imperial College London	Faculty	Natural Sciences
Teaching Institution	Imperial College London	Department	Mathematics
Associateship	Royal College of Science	Main Location(s) of Study	South Kensington Campus
External Reference			
Relevant QAA Benchmark Statement(s) and/or other external reference points		Mathematics, Statistics and Operations Research	
FHEQ Level		Level 6 - Bachelors	
EHEA Level		1st cycle	
External Accreditor(s) (if applicable)			
External Accreditor 1:	N/A		
Accreditation received:	N/A	Accreditation renewal:	N/A
Collaborative Provision			
Collaborative partner	Collaboration type	Agreement effective date	Agreement expiry date
N/A	N/A	N/A	N/A
Specification Details			

Programme Lead	Dr. Christopher Hallsworth
Student cohorts covered by specification	2022-23 entry
Date of introduction of programme	October 2019
Date of programme specification/revision	October 2022

Programme Overview

The Mathematics Degree programme at Imperial College London aims to present a wide range of mathematical ideas in a way which enables you to develop your critical and intellectual abilities. It encourages enthusiasm for the subject as a living discipline that is of value both in its own right and in its applications. It aims to provide a good knowledge of a broad range of topics in mathematics and to allow you to acquire a more advanced knowledge of selected parts of the subject. You will have the opportunity to develop an appreciation of topics which lead into current research in Mathematics and applications of Mathematics. As a student on this programme, you will take a substantial number of modules in Applied Mathematics and/or Mathematical Physics.

All of the modules in year 1 and around two-thirds of the modules in year 2 are core. These provide a solid foundation in fundamental mathematical topics and their applications. In the second year, you will also take a number of elective modules and specialise in applications of Mathematics. During the final year of the programme you will choose from a large selection of modules across a very wide range of areas of Mathematics and its applications but focussing on Applied Mathematics and/or Mathematical Physics. In years 2 and 3 you may also take a limited number of modules delivered outside the department.

Teaching of Mathematics modules takes place at the College's South Kensington Campus. Studying at a research intensive institution, you will learn from specialists in their subject areas. Most teaching sessions are delivered by staff from the Department of Mathematics. These are predominantly permanent academic staff who are actively engaged in research, but also include teaching fellows and research associates. Problem classes are supported by Graduate Teaching Assistants and your first-year studies will be supported by small-group tutorials with a member of staff and with a higher-year student.

Our programme is designed to develop personal attributes that employers value, including effective time management and resilience, good interpersonal, leadership, computational, analytical and problem solving skills, as well as developing independent research skills and your verbal and written presentation skills. You will have the opportunity to develop mathematical and communication skills that will be useful in scientific or other jobs.

Mathematics graduates join various employment sectors, including financial, technology and consultancy. The programme also provides an excellent foundation for postgraduate study, enabling you to progress to Master's and PhD programmes, and then to carry on to pursue a career in academic research, or high-skilled employment.

Learning Outcomes

Students who have fulfilled all the requirements of the programme will be awarded a **BSc (Honours)** degree. On successful completion of the programme, you will be able to:

- demonstrate an understanding of core material and more specialised areas by assimilating and applying a large body of complex, inter-related concepts;
- demonstrate an in-depth understanding of Applied Mathematics and/or Mathematical Physics;
- use logical mathematical argument and deductive reasoning, together with formal processes of mathematical proof and development of mathematical theories;
- take a structured mathematical-analytical approach to problem solving, recognising the importance of assumptions made and consequences of their violation;
- apply Mathematics as a language to describe and model a wide range of situations relevant to research or industry, choosing appropriate solution methods and interpreting results;

- solve open-ended problems and problems with well-defined solutions by formulating problems in precise terms, identify key issues and try different approaches in order to make progress;
- develop programming skills and practices to further mathematical understanding and solve mathematical problems;
- communicate mathematical understanding concisely and appropriately in varied situations and to diverse audiences;
- manage and evaluate your learning, making appropriate choices for your self-development and use appropriate support and resources;
- work and plan effectively, both individually and as part of a team, making use of appropriate investigative methods.

Students not eligible for a BSc degree, may be awarded one of the following exit-awards.

Certificate of Higher Education: On completion of year 1 of the programme, you will be able to:

- demonstrate knowledge and understanding of core mathematical concepts and principles
- apply basic problem solving skills and mathematical techniques to solve well-defined problem sets
- construct a logical mathematical argument with understanding of the fundamentals, including identifying assumptions and making conclusions
- develop programming skills to solve mathematical problems
- communicate components of core material reasonably clearly to selected audiences
- demonstrate intellectual and personal development through the development of transferable, independent and group study and learning skills.

Diploma of Higher Education: On completion of years 1 and 2 of the programme, you will have achieved the above learning outcomes for the Certificate of Higher Education, and will be able to:

- demonstrate more in-depth knowledge and understanding of selected topics in mathematics and begin to develop a fuller appreciation of the subject and its many applications
- apply core concepts and principles both in well-defined contexts as well as more open ended questions and begin to develop understanding of some inter-relationships
- apply a further-developed understanding of deductive reasoning in the construction of logical mathematical arguments
- identify and use different mathematical approaches and techniques to solve and model problems, including understanding where some approaches will not work, and demonstrate skills in calculation and manipulation when solving these problems
- develop programming skills to model problems and further mathematical understanding
- communicate straightforward arguments and conclusions, both in core material and individual research, reasonably accurately and clearly, to varied audiences
- demonstrate personal development through taking ownership of own learning journey and making use of appropriate resources.

The Imperial Graduate Attributes are a set of core competencies which we expect students to achieve through completion of any Imperial College degree programme. The Graduate Attributes are available at: www.imperial.ac.uk/students/academic-support/graduate-attributes

Entry Requirements	
Academic Requirement	A-levels: Normally a minimum **A*A*A** overall **A*** in Mathematics **A*** in Further Mathematics **A** in one other A-level (not General Studies or Critical Thinking) IB minimum requirements: 39 overall; 7 in Mathematics at Higher Level; 6 in Physics, Chemistry or Economics at Higher Level. For further information on entry requirements, please go to https://www.imperial.ac.uk/study/ug/apply/requirements/ugacademic/

Non-academic Requirements	N/A
English Language Requirement	Higher requirement Please check for other Accepted English Qualifications
Admissions Test/Interview	Mathematics Admissions Test (MAT) or STEP papers. No interview.

The programme's competency standards documents can be found at:
http://www.imperial.ac.uk/mathematics/undergraduate/course-structure-and-content/

Learning & Teaching Approach

Learning and Teaching Delivery Methods

You will learn though a combination of lectures, problem classes, tutorials, computing lab classes, group work and self-study. Support for learning, in the form of tutorials and problem classes, is tapered. It is greater in the early stages of the programme, allowing students to develop into fully-independent learners by the end of the programme.

Lectures
Typically, a 5 ECTS module will have 20 lectures. In the core modules in years 1 and 2, you will be together with your whole cohort. In elective modules, particularly in year 3, the class size can be much smaller. Lecturers will take a variety of approaches. In some lectures, the lecturer will focus on presenting new material, often writing out arguments, examples and calculations by hand and adjusting the pace of the delivery to suit students' understanding. In other lectures, you may be expected to have studied material beforehand and the lecture will be an interactive session to develop your understanding.

Tutorials
In terms 1 and 2 of year 1, you will have a weekly tutorial with a staff member (usually your personal tutor) as part of a small group (around 5 or 6). You will also have a 'peer-tutorial' with a higher-year undergraduate or MSc student.

Problem-solving and group learning classes
In addition to lectures, most year 1 and 2 modules are supported by classes delivered by at least one staff member, normally the lecturer, supported by a team of Graduate Teaching Assistants. The classes are usually delivered to all students on the module, divided into a number of rooms. You will be expected to prepare for these classes by working on problem sheets produced by the lecturers. Activities in the classes can include: working in small groups with the assistance of a GTA or the lecturer; engaging with presentations of solutions to the problems or working on challenging unseen problems individually or in groups.
In year 3, lecturers will include regular problem-solving sessions as part of their timetabled lectures.

Independent learning
You will be expected to spend a substantial amount of time on independent study. This will include preparation for and working on material from lectures; working through problem sheets and other formative assignments either individually or in groups; other preparation for tutorials and problem-solving/group learning classes; producing coursework for submission and assessment; preparation for examinations.

Group Learning
You will have the opportunity to work in groups through tutorials, projects and assessments. These opportunities will give you the opportunity to deepen your mathematical understanding and develop improved communications and team work skills.

Research Projects
In term 3 of years 1 and 2, you will undertake a short research-oriented project. The year 1 project is an individual project and the year 2 project is a group project (in a group of around 5 students) directed by a member of staff. In year 3, you may complete a 7.5 ECTS Research Project as one of your elective modules.

Overall Workload

Your overall workload consists of face-to-face sessions and independent learning. While your actual contact hours may vary according to the optional modules you choose to study, the following gives an indication of how much time you will need to allocate to different activities at each level of the programme. At Imperial, each ECTS credit taken equates to an expected total study time of 25 hours. Therefore, the indicative total study time is 1500 hours per year. As these are indicative study times, you may need to make reasonable adjustments to these suggested times to account for your individual learning style.

During year 1 you will typically spend around 22 percent (330 hours) of your time in lectures, problem classes and tutorials. In year 2 it will be around 20 percent (300 hours), and around 16 percent (240 hours) in year 3. The remaining time is for self-study.

Assessment Strategy

Assessment Methods

A variety of assessment methods will be used to test your understanding. Assessments may be formative, summative or both.

Formative assessments do not contribute to the module mark but provide information on your progress as an individual and in the context of your peers. This allows you to learn by using your new skills to solve problems and receive feedback on your performance to guide your future learning. This supports you to achieve a better performance in the summative assessments which do count towards your module marks. Common types of formative assessment used include: regular question sheets, questions posed by a lecturer in lectures, and exercises set by your tutor or peer-tutor.

Summative assessments are used to assess your learning against the intended module learning outcomes and contribute towards your achievement of the programme learning outcomes, detailed above. All modules contain aspects of summative assessment and these assessments will contribute towards your mark for each year. Usually the grades for summative assessment are assigned by lecturers or graduate teaching assistant but occasionally your work will be peer assessed (i.e. your grade is provided by one or more of your fellow students).
The choice of summative assessment method is largely determined by the nature of the module and its learning outcomes.
A variety of different summative assessment methods is used, including:

- Written examinations
- Short, individual tests
- Group assignments and projects
- Individual Projects
- Online tests and quizzes
- Oral presentations
- Poster presentations.

Lecture modules in all years typically involve an end-of-year examination and some element of coursework or short tests during the module. In year 1 the end-of-year examination is usually worth 70 percent of the module; this typically increases to 80 percent in year 2 and 90 percent in year 3. Some modules, notably ones with a high computational or data analysis element, may have a higher proportion of coursework or may be assessed entirely a number of projects (which may also involve presentations).

Academic Feedback Policy

Feedback will be provided in a number of formats:

- Oral (i.e. face-to-face) during problem classes and tutorials
- Personal (discussion with staff)
- Written (e.g. model answers, group feedback, individual comments written on coursework)
- Interactive (online quizzes).

Oral feedback on formative work is available in problem classes, lecturers' office hours and tutorials.

Written feedback on coursework and tests will normally be provided within 2 weeks. Written feedback is provided on projects. As feed-forward, students may view and discuss with an appropriate lecturer the marked scripts from their year 1 and 2 exams. The College's Policy on Academic Feedback and guidance on issuing provisional marks to students is available at: www.imperial.ac.uk/about/governance/academic-governance/academic-policy/exams-and-assessment/
Re-sit Policy
The College's Policy on Re-sits is available at: www.imperial.ac.uk/student-records-and-data/for-current-students/undergraduate-and-taught-postgraduate/exams-assessments-and-regulations/
Mitigating Circumstances Policy
The College's Policy on Mitigating Circumstances is available at: www.imperial.ac.uk/student-records-and-data/for-current-students/undergraduate-and-taught-postgraduate/exams-assessments-and-regulations/

Additional Programme Costs		
This section should outline any additional costs relevant to this programme which are not included in students' tuition fees.		
Description	Mandatory/Optional	Approximate cost
N/A	N/A	N/A

Important notice: The Programme Specifications are the result of a large curriculum and pedagogy reform implemented by the Department and supported by the Learning and Teaching Strategy of Imperial College London. The modules, structure and assessments presented in this Programme Specification are correct at time of publication but might change as a result of student and staff feedback and the introduction of new or innovative approaches to teaching and learning. You will be consulted and notified in a timely manner of any changes to this document.

Programme Structure[1]

Year 1 – FHEQ Level 4
Students study all core modules.

Code	Module Title	Core/ Compulsory/ Elective	Group*	Term	Credits
MATH40001	Introduction to University Mathematics	Core (pass/fail)	-	1	5
MATH40002	Analysis 1	Core	-	1,2	10
MATH40003	Linear Algebra and Groups	Core	-	1,2	10
MATH40004	Calculus and Applications	Core	-	1,2	10
MATH40005	Probability and Statistics	Core	-	1,2	10
MATH40006	Introduction to Computation	Core	-	1,2	5
MATH40007	An Introduction to Applied Mathematics	Core	-	2	5
MATH40008	Individual Research Project	Core	-	3	5
				Credit Total	60

Year 2 - FHEQ Level 5
Students study all core modules. Select one module from Group A and 3 modules from Group B. Electives can be prerequisites for year 3 modules, but students will be advised about such dependencies prior to making their choice of year 2 electives; prerequisites can be varied at the discretion of the Department.

Code	Module Title	Core/ Compulsory/ Elective	Group	Term	Credits
MATH50001	Analysis 2	Core	-	1,2	10
MATH50003	Linear Algebra and Numerical Analysis	Core	-	1,2	10
MATH50004	Multivariable Calculus and Differential Equations	Core	-	1,2	10
MATH50008	Partial Differential Equations in Action	Core	-	2	5
MATH50002	Group Research Project	Core	-	3	5
	I-Explore	Compulsory (pass/ fail)	A	1 &/or 2	5 or 7.5

[1] **Core** modules are those which serve a fundamental role within the curriculum, and for which achievement of the credits for that module is essential for the achievement of the target award. Core modules must therefore be taken and passed in order to achieve that named award. **Compulsory** modules are those which are designated as necessary to be taken as part of the programme syllabus. Compulsory modules can be compensated. **Elective** modules are those which are in the same subject area as the field of study and are offered to students in order to offer an element of choice in the curriculum and from which students are able to select. Elective modules can be compensated.

MATH50005	Groups and Rings	Elective	B	1	5
MATH50007	Network Science	Elective	B	1	5
MATH50010	Probability for Statistics	Elective	B	1	5
MATH50006	Lebesgue Measure and Integration	Elective	B	2	5
MATH50009	Principles of Programming	Elective	B	2	5
MATH50011	Statistical Modelling 1	Elective	B	2	5
				Credit Total	60 or 62.5

Year 3 - FHEQ Level 6
All group A modules are level 6. The list of modules is indicative only. Students choose: at least 52.5 ECTS from Group A and D combined with at least 37.5 ECTS from group D; at most one module from group C. Modules must total to at least 60 ECTS, but not more than 62.5. Modules from other departments or level 7 Mathematics modules may be allowed with the permission of DUGS.

Code	Module Title	Core/ Compulsory/ Elective	Group	Term	Credits
MATH60029	Functional Analysis	Elective	A	1	7.5
MATH60031	Markov Processes	Elective	A	1	7.5
MATH60032	Geometry of Curves and Surfaces	Elective	A	1	7.5
MATH60033	Algebraic Curves	Elective	A	1	7.5
MATH60034	Algebraic Topology	Elective	A	1	7.5
MATH60035	Algebra 3	Elective	A	1	7.5
MATH60036	Group Theory	Elective	A	1	7.5
MATH60038	Graph Theory	Elective	A	1	7.5
MATH60041	Number Theory	Elective	A	1	7.5
MATH60045	Applied Probability	Elective	A	1	7.5
MATH60046	Time Series Analysis	Elective	A	1	7.5
MATH60047	Stochastic Simulation	Elective	A	1	7.5
MATH60049	Introduction to Statistical Learning	Elective	A	1	7.5
MATH60028	Probability Theory	Elective	A	2	7.5
MATH60030	Fourier Analysis and the Theory of Distributions	Elective	A	2	7.5
MATH60037	Galois Theory	Elective	A	2	7.5

MATH60039	Group Representation Theory	Elective	A	2	7.5
MATH60040	Formalising Mathematics	Elective	A	2	7.5
MATH60042	Algebraic Number Theory	Elective	A	2	7.5
MATH60043	Statistical Theory	Elective	A	2	7.5
MATH60044	Statistical Modelling 2	Elective	A	2	7.5
MATH60048	Survival Models	Elective	A	2	7.5
MATH60132	Mathematical Logic	Elective	A	1	7.5
MATH60131	Consumer Credit Risk Modelling	Elective	A	1	7.5
MATH60001	Fluid Dynamics 1	Elective	D	1	7.5
MATH60004	Asymptotic Methods	Elective	D	1	7.5
MATH60006	Applied Complex Analysis	Elective	D	1	7.5
MATH60007	Dynamics of Learning and Iterated Games	Elective	D	1	7.5
MATH60008	Dynamical Systems	Elective	D	1	7.5
MATH60011	Classical Dynamics	Elective	D	1	7.5
MATH60012	Mathematical Finance: An Introduction to Option Pricing	Elective	D	1	7.5
MATH60013	The Mathematics of Business and Economics	Elective	D	2	7.5
MATH60015	Quantum Mechanics 1	Elective	D	1	7.5
MATH60016	Special Relativity and Electromagnetism	Elective	D	1	7.5
MATH60019	Theory of Partial Differential Equations	Elective	D	1	7.5
MATH60020	Function Spaces and Applications	Elective	D	1	7.5
MATH60023	Numerical Solution of Ordinary Differential Equations	Elective	D	1	7.5
MATH60024	Computational Linear Algebra	Elective	D	1	7.5
MATH60026	Methods for Data Science	Elective	D	1	7.5
MATH60002	Fluid Dynamics 2	Elective	D	2	7.5
MATH60003	Introduction to Geophysical Fluid Dynamics	Elective	D	2	7.5
MATH60005	Optimisation	Elective	D	2	7.5
MATH60009	Bifurcation Theory	Elective	D	2	7.5
MATH60010	Geometric Mechanics	Elective	D	2	7.5
MATH60017	Tensor Calculus and General Relativity	Elective	D	2	7.5

MATH60018	Quantum Mechanics 2	Elective	D	2	7.5
MATH60021	Advanced Topics in Partial Differential Equations	Elective	D	2	7.5
MATH60022	Finite Elements: Numerical Analysis and Implementation	Elective	D	2	7.5
MATH60025	Computational Partial Differential Equations	Elective	D	2	7.5
MATH60027	Scientific Computation	Elective	D	2	7.5
MATH60050	Research Project in Mathematics	Elective	D	2 and 3	7.5
MATH50005	Groups and Rings	Elective (level 5)	B	1	5
MATH50007	Network Science	Elective (level 5)	B	1	5
MATH50010	Probability for Statistics	Elective (level 5)	B	1	5
MATH50006	Lebesgue Measure and Integration	Elective (level 5)	B	2	5
MATH50008	Partial Differential Equations in Action	Elective (level 5)	B	2	5
MATH50009	Principles of Programming	Elective (level 5)	B	2	5
MATH50011	Statistical Modelling 1	Elective (level 5)	B	2	5
	Horizons or BPES module	Elective	C	1 &/or 2	5 or 7.5
				Credit Total	60-62.5 ECTS

* ‘Group’ refers to module grouping (e.g. a group of electives from which one/two module(s) must be chosen).

Progression and Classification

Progression

In order to progress to the next level of study, you must have passed all modules (equivalent to 60 ECTS) in the current level of study at first attempt, at resit or by a compensated pass.

The overall weighted average for each year must be 40.00%, including where a module(s) has been compensated, in order for you to progress to the next year of the programme.

In year 2 the Board of Examiners may apply compensation in elective modules up to a value of 10 ECTS.

In year 3 the Board of Examiners may apply compensation in elective modules up to a value of 15 ECTS

Classification

The raw marks from each assessment will be weighted and combined to produce a raw module mark; the raw module mark will then be converted to a 0-100 scale.

Due to the nature of Mathematics as an academic discipline it is often necessary for module marks to be scaled in order to ensure comparability across modules and so that they map appropriately onto the undergraduate degree classification system. In accordance with the Regulations , this process is applied consistently to all students in the cohort and reported to External Examiners and the Board of Examiners. Further details regarding the Department's approach to scaling may be found in the programme handbook.

The agreed mark for each module will be used to calculate year marks and final classifications using a weighted average.

The marks from modules in each year contribute towards the final degree classification.

In order to be considered for an award, you must have achieved the minimum number of credits at the required levels prescribed for that award and met any programme specific requirements as set out in the Programme Specification.

Your classification will be determined through:

i) Aggregate Module marks for all modules
ii) Year Weightings

For this award, Year One is weighted at 7.50%, Year Two at 35.00% and Year Three at 57.50%.

In a case where a student has accumulated more than 60 ECTS in year 3, modules in option range A will be weighted as if the student had taken 60 ECTS; modules in option ranges B and C will have reduced weighting.

The College sets the class of undergraduate degree that may be awarded as follows:

i)	First	70.00% or above for the average weighted module results
ii)	Upper Second	60.00% or above for the average weighted module results
iii)	Lower Second	50.00% or above for the average weighted module results
iv)	Third	40.00% or above for the average weighted module results

Candidates who do not meet the specific requirements for this degree coding may be transferred to, or be graduated with another BSc Mathematics coding (including G100) for which the requirements have been met.

Please find the full Academic Regulations at https://www.imperial.ac.uk/about/governance/academic-governance/regulations/. Please follow the prompts to find the set of regulations relevant to your programme of study.
Programme Specific Regulations
Note the comments regarding scaling and treatment of ‘excess’ credit.

Supporting Information
The Programme Handbook is available at: TBD
The Module Handbook is available at: TBD
The College's entry requirements for postgraduate programmes can be found at: www.imperial.ac.uk/study/pg/apply/requirements
The College's Quality & Enhancement Framework is available at: www.imperial.ac.uk/registry/proceduresandregulations/qualityassurance
The College's Academic and Examination Regulations can be found at: www.imperial.ac.uk/about/governance/academic-governance/regulations
Imperial College is an independent corporation whose legal status derives from a Royal Charter granted under Letters Patent in 1907. In 2007 a Supplemental Charter and Statutes was granted by HM Queen Elizabeth II. This Supplemental Charter, which came into force on the date of the College's Centenary, 8th July 2007, established the College as a University with the name and style of "The Imperial College of Science, Technology and Medicine". www.imperial.ac.uk/admin-services/secretariat/college-governance/charters/
Imperial College London is regulated by the Office for Students (OfS) www.officeforstudents.org.uk/advice-and-guidance/the-register/
This document provides a definitive record of the main features of the programme and the learning outcomes that a typical student may reasonably be expected to achieve and demonstrate if s/he takes full advantage of the learning opportunities provided. This programme specification is primarily intended as a reference point for prospective and current students, academic and support staff involved in delivering the programme and enabling student development and achievement, for its assessment by internal and external examiners, and in subsequent monitoring and review.

Modifications			
Description	**Approved**	**Date**	**Paper Reference**
N/A	N/A	N/A	N/A