

BEng Mathematics and Computer Science

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 intended as a reference point for prospective students, current students, external examiners and academic and support staff involved in delivering the programme and enabling student development and achievement.

Programme Information

Programme Title	Mathematics and Computer Science			
Award(s)	BEng			
Programme Code	GG14			
Awarding Institution	Imperial College London			
Teaching Institution	Imperial College London			
Faculty	Faculty of Engineering			
Department	Department of Computing			
Main Location of Study	South Kensington Campus			
Mode and Period of Study	3 academic years, full-time			
Cohort Entry Points	Annually in October			
Relevant QAA Benchmark Statement(s) and/or other external reference points	Computing			
Total Credits	ECTS:	190-210	CATS:	380-420
FHEQ Level	Level 6			
EHEA Level	1 st cycle			
External Accrator(s)	BCS – The Chartered Institute for IT The Institution of Engineering and Technology (IET)			
Specification Details				
Student cohorts covered by specification	2018/19 and previous entry cohorts			
Person responsible for the specification	Dr Damian Cerase, Teaching Quality Officer			
Date of introduction of programme	-			
Date of programme specification/revision	October 2019			

Programme Overview

With the spread of computing procedures and mathematical ideas into many areas, there is high demand for professionals who are expert in both.

Our Mathematics and Computer Science degrees are mathematical courses orientated towards computing science.

Taught jointly by the Departments of Computing and Mathematics, they provide a firm foundation in mathematics, particularly in pure mathematics, numerical analysis and statistics. They also cover all the essentials of computer science, with an emphasis on developing software, as well as more theoretical topics.

This makes the courses particularly suited to mathematically-able students with interests in both subjects.

During the first two years you take core modules from both departments and complete project work, with the chance to choose some optional modules in the second year.

In the third year you can choose from a wide variety of optional modules offered by the departments to suit your interests, and will also complete a substantial individual project.

Learning Outcomes

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

Knowledge and Understanding of:

- Major paradigms of programming – functional, declarative, imperative and object-oriented;
- Basic computing, including programming, program design, human-computer interaction, e-commerce, computer systems, hardware, network and communications, compilers, databases and many application areas such as graphics and artificial intelligence;
- Underlying mathematics including logic, discrete mathematics, methods and statistics, computability theory, complexity, pure mathematics, numerical analysis and statistics;
- Formal practical programming and mathematical skills, including specification and reasoning;
- The development of the application of Mathematics as a language in a wide range of situations relevant to research and industry;
- Problem-solving strategies and methods;

Intellectual Skills - able to:

- Analyse and formally specify and solve programming, computing system and mathematical design problems of different types;
- Reason about program correctness and algorithm complexity;
- Understand the role of logical mathematical argument and reasoning, together with formal methods of proof and development;
- Construct and solve abstract and mathematical models of computer and communication systems;

- Use mathematics to describe and model applications, to identify appropriate solution methods, and to interpret and analyse results;
- Match problems to techniques and tool most suitable for solving them;
- Perform critical evaluation of alternative designs and implementation;
- Design experiments for the purpose of testing;

Practical Skills:

- Design and develop programs of varying levels of complexity using a number of different programming languages and paradigms, for example object-oriented programming, logic programming, functional programming and imperative programming;
- Use many computing tools and techniques, such as database, web-based and graphic tools and techniques;
- Use symbolic and numerical software as part of practical computation;
- Analyse computing and mathematical problems and devise solutions to them;

Transferable Skills:

- Communicate effectively by presenting complex information in a clear and concise manner orally, by computer presentations and in written reports;
- Program in the major computer programming paradigms;
- Use the internet effectively, respecting professional conduct and professional ethics;
- Integrate and evaluate information from multiple and diverse sources;
- Work independently, use their problem solving initiative, organise themselves to meet deadlines.
- Work within and contribute to a team, using management skills such as co-ordination, decision processes, project design and evaluation;
- Transfer techniques and solutions from one area to another;
- Learn independently with open-mindedness and critical enquiry;
- Learn effectively for the purpose of continuing professional development;

Entry Requirements

Academic Requirement	Grade Requirement	Normally a minimum A*AA overall
	Subject Requirements	A* in Mathematics A in Further Mathematics is highly recommended
	Excluded Subjects	ICT, Business Studies and General Studies
International Baccalaureate (IB)	Grade Requirement	Minimum 39 overall
	Subject Requirements	7 in Mathematics 7 in one further relevant subject (such as Physics, Computer Science, Chemistry, Economics or Biology)
English Language Requirement		Standard requirement IELTS score of 6.5 overall (minimum 6.0 in all elements)

Admissions Tests	An entrance test will be required if the applicant is unable to attend an interview
Interview	Yes
The programme's competency standards document can be found at: http://www.imperial.ac.uk/computing/prospective-students/courses/ug/competence/	
Learning & Teaching Strategy	
Scheduled Learning & Teaching Methods	<ul style="list-style-type: none"> • Problem sheet classes; • Tutorials; • Lectures; • Laboratory; • Seminars;
Project and Placement Learning Methods	<ul style="list-style-type: none"> • Group project; • Independent research project
Assessment Strategy	
Assessment Methods	<ul style="list-style-type: none"> • Unseen written examinations; • Unseen practical tests; • Coursework; • Laboratory work; • Group projects; • Individual projects; • Presentations; • Problem sheets; • Online tests; • Programming tests; • Reports;
Academic Feedback Policy	
<p>Feedback will be provided on coursework within two weeks of submission. This will be in the form of, for example:</p> <ul style="list-style-type: none"> • Personal discussion • Discussions in small-group tutorials • Marked-up coursework, laboratory exercises or tests • Verbal presentation, e.g. during or after lectures • Written class-wide summaries • Interactive problem solving sessions • Model answers to coursework <p>In lieu of feedback on examinations, selected examination questions are routinely set as unassessed problems in the following year, with model answers provided.</p>	
Re-sit Policy	

In line with College policy, students who are unsuccessful in any of their examinations may usually be allowed an opportunity to re-sit at the discretion of the Board of Examiners.

Students in the Faculty of Engineering who have marginally failed a year may be offered the chance to undertake a Supplementary Qualifying Test (SQT) at the discretion of the Board of Examiners in order to progress into the next year.

The College's Policy on Examination Re-sits and SQTs is available at:

<https://www.imperial.ac.uk/about/governance/academic-governance/academic-policy/exams-and-assessment/>

Further information regarding re-sits for BEng, MEng, BSc and MSci degrees in the Faculty of Engineering can be found in the relevant Academic Regulations available at:

<https://www.imperial.ac.uk/about/governance/academic-governance/regulations/>

Mitigating Circumstances Policy

Students may be eligible to apply for mitigation if they have suffered from serious and unforeseen circumstances during the course of their studies that have adversely affected their ability to complete an assessment task and/or their performance in a piece of assessment.

The College's Policy on Mitigating Circumstances is available at:

<https://www.imperial.ac.uk/about/governance/academic-governance/academic-policy/exams-and-assessment/>

Assessment Structure

Marking Scheme

Year One

In order to pass Year 1 and qualify to progress to the second year, the candidate must satisfy the following conditions:

- Achieved at least 40% in each of the Mathematics and Computing assessments;
- Achieved at least 40% in the Computing coursework;
- Achieved at least 40% in Programming.

Year Two

In order to pass Year 2 and qualify to progress to the third year, the candidate must satisfy the following conditions:

- Achieved at least 40% in each of the Mathematics and Computing examinations;
- Achieved at least 40% in Laboratory 2.

Year Three

In order to pass Year 3 and qualify for Honours, the candidate must satisfy the following conditions:

- Achieved at least 40% in the Individual Project;
- Achieved at least 40% overall for the final year.

Final Degree Classifications

Third – a student must achieve an aggregate mark of 40%
 Lower Second – a student must achieve an aggregate mark of 50%
 Upper Second – a student must achieve an aggregate mark of 60%
 First - a student must achieve an aggregate mark of 70%

Module Weightings		
Year	Module	Module Weighting %
1 (16.7%)	Logic	7.43%
	Foundations of Analysis	12.50%
	Mathematical Methods I	12.50%
	Programming I	8.64%
	Programming II	11.34%
	Laboratory 1	0.00%
	Reasoning About Programs	6.00%
	Graphs and Algorithms	7.43%
	Computing Topics	2.00%
	Ethics in Computing 1	0.15%
	Presentation Skills	0.00%
	Applied Methods and Linear Algebra	12.50%
	Algebra and Analysis	12.50%
	Programming III (JMC)	7.02%
Students may select up to 2 x extracurricular modules (EX1) in year 1	0.00%	
2 (33.3%)	Software Engineering Design	7.00%
	Statistical Methods	12.13%
	Laboratory 2	12.50%
	Operating Systems	7.00%
	Introduction to Prolog	0.00%
	Introduction to Numerical Analysis	12.13%
	An Introduction to Law for Computer Scientists	0.00%
		7.0%
	3 x modules from elective group (A)	7.0%
	1 x module from elective group (B)	4.0%
	1 x module from elective group (C)	12.1%
	1 x module from elective group (D)	12.1%
In addition to the elective modules, students may select 1 x extracurricular module (EX2) in year 2	0.00%	
3 (50%)	3rd Year Software Engineering Group Project	14.00%
	1 x module from elective group (E)	23.0%
	AT LEAST 2 x modules from elective group (F)	9.0%
	NO MORE THAN 1 x module from elective group (G)	9.0%
	NO MORE THAN 2 x modules from elective group (H)	9.0%
	NO MORE THAN 2 x modules from elective group (I)	9.0%
	NO MORE THAN 5 x modules from elective group (J)	9.0%
In addition to the elective modules, students may select 1 x extracurricular module (EX3) in year 3	0.0%	

Indicative Module List									
Code	Title	Core/ Elective	Year	L&T Hours	Ind. Study Hours	Place- ment Hours	Total Hours	FHEQ Level	ECTS
CO120.1	Programming 1 (Haskell)	Core	1	31	169	0	200	4	8
CO120.2	Programming 2 (Java)	Core	1	13.5	186.5	0	200	4	8
CO120.3J	Programming 3 (JMC)	Core	1	52	148	0	200	4	8
CO140	Logic	Core	1	27	85.5	0	112.5	4	4.5
CO141	Reasoning About Programs	Core	1	27	85.5	0	112.5	4	4.5
CO150	Graphs and Algorithms	Core	1	See module leader			100	4	4
CO161	Laboratory 1	Core	1	176	0	0	N/A	4	0
CO163	Computing Topics	Core	1	11	64	0	75	4	3
CO164	Ethics in Computing 1	Core	1	4	0	0	N/A	4	0
CO165	Presentation Skills	Core	1	6	0	0	N/A	4	0
M1F	Foundations of Analysis	Core	1	40	122.5	0	162.5	4	6.5
M1J1	Applied Methods and Linear Algebra	Core	1	See module leader			162.5	4	6.5
M1J2	Algebra and Analysis	Core	1	See module leader			162.5	4	6.5
M1M1	Mathematical Methods 1	Core	1	39	123.5	0	162.5	4	6.5

Indicative Module List									
Code	Title	Core/ Elective	Year	L&T Hours	Ind. Study Hours	Place- ment Hours	Total Hours	FHEQ Level	ECTS
CO191	Advanced Programming	EX1	1	18	0	0	18	4	0
CO701	Programming Competition Training	EX1	1	N/A				4	0
CO211	Operating Systems	Core	2	See module leader			100	5	4
CO220	Software Engineering Design	Core	2	See module leader			100	5	4
CO261	Laboratory 2	Core	2	See module leader			525	5	15
CO273	An Introduction to Law for Computer Scientists	Core	2	See module leader			N/A	5	0
CO276	Introduction to Prolog	Core	2	See module leader			N/A	5	0
M2AA3	Introduction to Numerical Analysis	Core	2	40	135	0	175	5	7
M2SJ	Statistical Methods	Core	2	30	145	0	175	5	7
CO202	Algorithms 2	Elective (A)	2	27	73	0	100	5	4
CO221	Compilers	Elective (A)	2	See module leader			100	5	4
CO231	Introduction to Model-based Artificial Intelligence	Elective (A)	2	See module leader			100	5	4
CO240	Models of Computation	Elective (A)	2	See module leader			100	5	4

Indicative Module List									
Code	Title	Core/ Elective	Year	L&T Hours	Ind. Study Hours	Place- ment Hours	Total Hours	FHEQ Level	ECTS
CO271	2nd Year Computing Group Project	Elective (B)	2	See module leader			175	5	7
M2R	2nd Year Maths Group Project	Elective (B)	2	3.5	121.5	0	125	5	5
M2AA2	Multivariable Calculus	Elective (C)	2	40	135	0	175	5	7
M2PM1	Real Analysis	Elective (C)	2	39	136	0	175	5	7
M2AM	Non-linear Waves	Elective (D)	2	38	137	0	175	5	7
M2PM3	Complex Analysis	Elective (D)	2	38	137	0	175	5	7
M2S2	Statistical Modelling 1	Elective (D)	2	38	137	0	175	5	7
CO212	Networks and Communications	EX2	2	See module leader			100	5	4
CO261C	Advanced Laboratory 2	EX2	2	See module leader			N/A	5	0
CO701	Programming Competition Training	EX2	2	See module leader			N/A	4	0
CO362	3rd Year Software Engineering Group Project	Core	3	See module leader			250	6	10
CO301J	Individual Project BEng - JMC	Elective (E)	3	See module leader			350	6	14
M3R	Maths Individual Project BEng - JMC	Elective (E)	3	See module leader			200	6	8
CO303	Systems Verification	Elective (F)	3	See module leader			125	6	5

Indicative Module List									
Code	Title	Core/ Elective	Year	L&T Hours	Ind. Study Hours	Place- ment Hours	Total Hours	FHEQ Level	ECTS
CO304	Logic-Based Learning	Elective (F)	3	See module leader			125	6	5
CO572	Advanced Databases	Elective (F)	3	See module leader			125	6	5
CO315	Computer Vision	Elective (F)	3	See module leader			125	6	5
CO317	Graphics	Elective (F)	3	See module leader			125	6	5
CO318	Custom Computing	Elective (F)	3	See module leader			125	6	5
CO322	Communicating Computer Science in Schools	Elective (F)	3	See module leader			125	7	5
CO331	Network and Web Security	Elective (F)	3	See module leader			125	6	5
CO332	Advanced Computer Architecture	Elective (F)	3	See module leader			125	6	5
CO333	Robotics	Elective (F)	3	See module leader			125	6	5
CO337	Simulation and Modelling	Elective (F)	3	See module leader			125	6	5
CO338	Pervasive Computing	Elective (F)	3	See module leader			125	6	5
CO339	Performance Engineering	Elective (F)	3	See module leader			125	7	5
CO343	Operations Research	Elective (F)	3	See module leader			125	6	5
CO347	Distributed Algorithms	Elective (F)	3	See module leader			125	6	5

Indicative Module List									
Code	Title	Core/ Elective	Year	L&T Hours	Ind. Study Hours	Place- ment Hours	Total Hours	FHEQ Level	ECTS
CO382	Type Systems for Programming Languages	Elective (F)	3	See module leader			125	6	5
CO395	Introduction to Machine Learning	Elective (F)	3	See module leader			125	6	5
CO527	Computer Networks and Distributed Systems	Elective (F)	3	See module leader			125	7	5
CO240	Models of Computation	Elective (F)	3	See module leader			100	5	4
CO202	Algorithms 2	Elective (F)	3	27	73	0	100	5	4
-	Business School Modules	Elective (G)	3	Variable				6	6
-	Horizons Modules	Elective (G)	3	Variable				6	6
M2AA1	Differential Equations	Elective (H)	3	38	137	0	175	5	7
M2AA2	Multivariable Calculus	Elective (H)	3	40	135	0	175	5	7
M2AM	Non-linear Waves	Elective (H)	3	38	137	0	175	5	7
M2PM1	Real Analysis	Elective (H)	3	39	136	0	175	5	7
M2PM2	Algebra 2	Elective (H)	3	39	136	0	175	5	7
M2PM3	Complex Analysis	Elective (H)	3	38	137	0	175	5	7

Indicative Module List									
Code	Title	Core/ Elective	Year	L&T Hours	Ind. Study Hours	Place- ment Hours	Total Hours	FHEQ Level	ECTS
M2PM5	Metric Spaces and Topology	Elective (H)	3	39	136	0	175	5	7
M2S2	Statistical Modelling 1	Elective (H)	3	38	137	0	175	5	7
CO526	Databases	Elective (I)	3	See module leader			100	7	4
M3A10	Fluid Dynamics 2	Elective (J)	3	90	110	0	200	6	8
M3A2	Fluid Dynamics 1	Elective (J)	3	90	110	0	200	6	8
M3A4	Mathematical Physics I: Quantum Mechanics	Elective (J)	3	90	110	0	200	6	8
M3A50	Methods for Data Science	Elective (J)	3	112	98	0	200	6	8
M3A6	Special Relativity and Electromagnetism	Elective (J)	3	90	110	0	200	6	8
M3A7	Tensor Calculus and General Relativity	Elective (J)	3	See module leader			200	6	8

Indicative Module List									
Code	Title	Core/ Elective	Year	L&T Hours	Ind. Study Hours	Place- ment Hours	Total Hours	FHEQ Level	ECTS
M3F22	Mathematical Finance: An Introduction to Option Pricing	Elective (J)	3	90	110	0	200	6	8
M3M3	An Introduction to Partial Differential Equations	Elective (J)	3	90	110	0	200	6	8
M3M7	Asymptotic Analysis	Elective (J)	3	102	98	0	200	6	8
M3N10	Computational Partial Differential Equations 1	Elective (J)	3	90	110	0	200	6	8
M3N7	Numerical Solution of Ordinary Differential Equations	Elective (J)	3	90	110	0	200	6	8
M3N9	Computational Linear Algebra	Elective (J)	3	90	110	0	200	6	8
M3P10	Group Theory	Elective (J)	3	90	110	0	200	6	8
M3P11	Galois Theory	Elective (J)	3	90	110	0	200	6	8
M3P12	Group Representation Theory	Elective (J)	3	90	110	0	200	6	8
M3P14	Number Theory	Elective (J)	3	90	110	0	200	6	8
M3P15	Algebraic Number Theory	Elective (J)	3	90	110	0	200	6	8
M3P17	Algebraic Combinatorics	Elective (J)	3	93	107	0	200	6	8

Indicative Module List									
Code	Title	Core/ Elective	Year	L&T Hours	Ind. Study Hours	Place- ment Hours	Total Hours	FHEQ Level	ECTS
M3P18	Fourier Analysis & Theory of Distributions	Elective (J)	3	90	110	0	200	6	8
M3P19	Measure and Integration	Elective (J)	3	87	113	0	200	6	8
M3P20	Geometry 1: Algebraic Curves	Elective (J)	3	90	110	0	200	6	8
M3P21	Geometry 2: Algebraic Topology	Elective (J)	3	90	110	0	200	6	8
M3P5	Geometry of Curves and Surfaces	Elective (J)	3	80	120	0	200	6	8
M3P6	Probability Theory	Elective (J)	3	90	110	0	200	6	8
M3P65	Mathematical Logic	Elective (J)	3	90	110	0	200	6	8
M3P7	Functional Analysis	Elective (J)	3	90	110	0	200	6	8
M3P8	Algebra 3	Elective (J)	3	90	110	0	200	6	8
M3PA23	Dynamical Systems	Elective (J)	3	90	110	0	200	6	8
M3PA24	Bifurcation Theory	Elective (J)	3	90	110	0	200	6	8
M3S1	Statistical Theory 1	Elective (J)	3	60	140	0	200	6	8
M3S14	Survival Models and Actuarial Applications	Elective (J)	3	90	110	0	200	6	8

Indicative Module List									
Code	Title	Core/ Elective	Year	L&T Hours	Ind. Study Hours	Place- ment Hours	Total Hours	FHEQ Level	ECTS
M3S16	Credit Scoring 1	Elective (J)	3	60	140	0	200	6	8
M3S2	Statistical Modelling 2	Elective (J)	3	70	130	0	200	6	8
M3S4	Applied Probability	Elective (J)	3	60	140	0	200	6	8
M3S8	Time Series	Elective (J)	3	90	110	0	200	6	8
M3S9	Stochastic Simulation 1	Elective (J)	3	60	140	0	200	6	8
M3T	Communicating Mathematics	Elective (J)	3	15.5	184.5	0	200	6	8
M3A49	Mathematical Biology	Elective (J)	3	30	170	0	200	6	8
M3PA48	Dynamics of Games	Elective (J)	3	30	170	0	200	6	8
M4P55	Commutative Algebra	Elective (J)	3	30	170	0	200	6	8
M3A29	Theory of Complex Systems	Elective (J)	3	30	170	0	200	6	8
M3A47	Finite Elements: Numerical Analysis and Implementation	Elective (J)	3	30	170	0	200	6	8
M3B	Mathematics of Business and Economics	Elective (J)	3	30	170	0	200	6	8
M3P70	Markov Processes	Elective (J)	3	30	170	0	200	6	8

Indicative Module List									
Code	Title	Core/ Elective	Year	L&T Hours	Ind. Study Hours	Place- ment Hours	Total Hours	FHEQ Level	ECTS
CO701	Programming Competition Training	EX3	3	N/A				4	0

Supporting Information

The Programme Handbook is available at: <http://www.imperial.ac.uk/computing/current-students/computing/ug-handbook/>

The Module Handbook is available at: <http://www.imperial.ac.uk/computing/current-students/computing/ug-handbook/>

The College's entry requirements for undergraduate programmes can be found at: www.imperial.ac.uk/study/ug/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: <http://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".

<http://www.imperial.ac.uk/admin-services/secretariat/college-governance/charters/charter-and-statutes/>

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