Imperial College London

Programme Specification for the MEng degrees in Mathematics and Computer Science

PLEASE NOTE. This specification provides a **concise** summary of the main features of the programme and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if he/she takes full advantage of the learning opportunities that are provided. This specification provides a source of information for students and prospective students seeking an understanding of the nature of the programme and may be used by the College for review purposes and sent to external examiners. More detailed information on the learning outcomes, content and teaching, learning and assessment methods of each module can be found on-line at http://www3.imperial.ac.uk/mathematics/students/undergraduate/courseguides

The accuracy of the information contained in this document is reviewed by the College and may be checked by the Quality Assurance Agency.

1. Awarding Institution: Imperial College London

2. Teaching Institution: Imperial College London

3. External Accreditation by Professional / Statutory Body:

IET, British Computer Society, Associate of the City and Guilds Institute (ACGI), Institute of Actuaries and Institute of Mathematics and its Applications

4. Name of Final Award: **MEng (Honours)**

5. Programme Titles:

GG41 Mathematics and Computer Science
IG11 Mathematics and Computer Science (Pure Maths and Computational Logic)
GI43 Mathematics and Computer Science (Computational Statistics)

6. Name of Department / Division: **Mathematics/Computing**

7. Name of Faculty: **Engineering**

8. UCAS Codes: **GG41/IG11/GI43**

9. Relevant QAA Subject Benchmarking Group(s) and/or other external/internal reference points

Mathematics, Statistics and Operational Research and Computer Science

10. Level(s) of programme within the Framework for Higher Education Qualifications (FHEQ):

Bachelor's (BSc, BEng, MBBS)	Level 6
Integrated Master's (MSci, MEng)	Levels 6 and 7
Master's (MSc, MRes)	Level 7

11. Mode of Study: **FULL TIME**

12. Language of Study: **English**

13. Date of Revision: **March 2015**

14. Educational aims/objectives of the programme

The programme aims/objectives are to:

- **All degrees:** Provide high quality education in both Computing and Mathematics techniques within an environment committed to excellence in both teaching and research.
- **For IG11:** Provide a specialisation and high quality education in Pure Mathematics and Logic topics.
- **For GI43:** Provide a specialisation and high quality education in Statistics and computational techniques linked to handling large statistical data sets
- To attract well-qualified students and provide intellectual challenge in a structure that contains an appropriate level of flexibility so that students can develop their special interests and skills for critical independent scholarship.
- To teach and provide the opportunities to learn a core of foundation topics in both mathematics and computing, together with a wide-range of options in both Mathematics and Computer Science.
- Place special emphasis on the fundamental principles underlying computing and give a solid background in mathematics relevant to computing and its applications.
- Introduce students to a wide-range of computing and mathematical applications
- Equip students with a range of computing and mathematical skills – in problem-solving, mathematics, applied computing, project work and presentations – which, individually and/or combined, will enable them to take prominent roles in a wide spectrum of employment and research.
- **Provide training in the professional aspects of computing and mathematics, including professional conduct and professional ethics;** give students extensive practical experience, through a wide range of supporting laboratory and problem solving classes and through project work.
- Provide some limited broadening of study through a range of Management and Humanities options.

15. Programme Learning Outcomes

I. Knowledge and Understanding

A. Knowledge and Understanding of:

1. Major paradigms of programming – functional, declarative, imperative and object-oriented.
2. 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.
3. Underlying mathematics including logic, discrete mathematics, methods and statistics, computability theory, complexity, pure mathematics, numerical analysis and statistics.
4. Formal practical programming and mathematical skills, including specification and reasoning.
5. The development of the application of Mathematics as a language in a wide range of situations relevant to research and industry.
6. Problem-solving strategies and methods

Teaching/learning methods and strategies

Acquisition of A1 to A4 and A6 is through compulsory and core courses in years 1 and 2 together with a combination of more specialised options in years 2 and 3. Lectures are an integral part of course delivery at Imperial College, supported by tutorial classes, tutorial groups, practical work, and office hours. All mathematics courses are accompanied by "problem-solving" worksheets, which students work through privately and supported by group tutorials. There is a project in each of year 1 [group maths project] and year 2 [group-based computing topic].

In the final year there is an individual project work that can be in either mathematics or computing.

Acquisition of A5 is through both individual and group supervised projects with accompanying reports and presentations.

Students are encouraged to undertake independent reading to supplement and consolidate what is being learned and to broaden their knowledge and understanding of computing.

Assessment of knowledge and understanding is through a combination of unseen written examinations, unseen practical tests, assessed coursework and laboratory work, group project documentation and presentations, individual project dissertation and presentation.

II. Skills and other Attributes

B. Intellectual Skills - able to:

1. Analyse and formally specify and solve programming, computing system and mathematical design problems of different types.
2. Reason about program correctness and algorithm complexity.
3. Understand the role of logical mathematical argument and reasoning, together with formal methods of proof and development.
4. Construct and solve abstract and mathematical models of computer and communication systems.
5. Use mathematics to describe and model applications, to identify appropriate solution methods, and to interpret and analyse results.
6. Match problems to techniques and tool most suitable for solving them.
7. Perform critical evaluation of alternative designs and implementation.
8. Design experiments for the purpose of testing

Teaching/learning methods and strategies
All lecture courses are accompanied by problem sheets, which students work through privately and during the tutorial hours integrated within the timetabled lecture period, and supported by group tutorials, which are separately timetabled for compulsory/core courses in year 1.
Skills B1-B3 are developed through the taught courses, the laboratory work, coursework and project work, skill B4 is developed throughout the laboratory program, assessed laboratory work, coursework and project work, skill B5 and B6 are acquired through core courses in years 1 and 2, and optional courses in the last two years, respectively. The remaining skills are developed through the group and individual projects.
Assessment is primary by unseen written examination, together with assessed coursework in the form of laboratory work, problem sheets or projects.
Mathematics lecture courses are also supported by problem sheet classes, group and individual tutorials, and access to lecturers informally and through a formal “office hours” system.

C. Practical Skills

1. 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.
2. Use many computing tools and techniques, such as database, web-based and graphic tools and techniques.
3. Use symbolic and numerical software as part of practical computation
4. Analyse computing and mathematical problems and devise solutions to them.

Teaching/learning methods and strategies
There are compulsory supervised laboratory and project work in year 1 and 2.
C1, 2 and 4 are taught and developed, throughout the degree, through the taught courses, laboratory program, the program design and programming courses, the assessed laboratory work, coursework and on-line tests, and the group and individual projects. C3 is taught and developed through the specialised optional courses, and through the group and individual project work.
Group projects in Computing are assessed through production of three written reports on software engineering methods applied to the project and a final technical report, including a detailed log, and technical presentation with product demonstration. Individual projects are assessed through detailed dissertation and demonstration. Other practical skills are assessed through laboratory work, coursework and on-line tests. The continuous assessment (laboratory work and coursework) throughout the degree and the programming tests provides valuable feedback for the staff and the students.

D. Transferable Skills

1. Communicate effectively by presenting complex information in a clear and concise manner orally, by computer presentations and in written reports.
2. Program in the major computer programming paradigms.
3. Use the internet effectively, respecting professional conduct and professional ethics.
4. Integrate and evaluate information from multiple and diverse sources.

5. Work independently, use their problem solving initiative, organize themselves to meet deadlines.
6. Work within and contribute to a team, using management skills such as co-ordination, decision processes, project design and evaluation.
7. Transfer techniques and solutions from one area to another.
8. Learn independently with open-mindedness and critical enquiry.
9. Learn effectively for the purpose of continuing professional development.

Teaching/learning methods and strategies

Acquisition of D1 is through feedback on coursework, supervised preparation of reports and presentations for the individual and group projects.

Acquisition of 2 comes through lectures and practical coursework. It is further developed in the individual project. Acquisition of D3, 4, 6 and 7 are through progressive problem solving, compulsory professional issues course in year 1, compulsory group projects in years 1, 2 and 3, and through a final year project. Acquisition of D5 is developed progressively throughout the course as students take control of their own learning, and have to meet a series of staged deadlines. 8 and 9 are not explicitly taught but are encouraged and developed throughout the degree.

D1 is assessed through coursework, reports, project presentations and written examinations. D2 is assessed through coursework and a laboratory based examination. D6 is assessed through group projects, whereas the other skills are not assessed formally, but are implicitly assessed through coursework and the group and individual project reports.

16. The following reference points were used in creating this programme specification

The following reference points were used in creating these Programme Specifications:

- Subject benchmarking information for Computing
- Subject benchmarking information for Mathematics, Statistics and Operational Research (QAA)
- All information being subject to approval by the Science Studies Committee of Imperial College.
- Student Handbook for Course approved by Senate of Imperial College

17. Programme structure and features, curriculum elements (modules), ECTS assignment and award requirements

This programme, is offered jointly by the two departments, and is designed as mathematical courses oriented towards computing science and is suited to mathematically able students with interests in **both** subjects. The programme gives a firm foundation in Mathematics, in particular Pure Mathematics, Numerical Analysis and Statistics, and covers all the essentials of Computer Science, with an emphasis on developing software and reasoning formally about it, as well as more theoretical topics. The teaching is divided approximately equally between the two Departments in the first two years, with the students given choice to lean towards either discipline with their subject selection in the third and fourth years.

These degrees are credit based and are run under Faculty of Engineering rules. Credit is awarded evenly between the two departments for the first two years, with students being able to decide to take more subjects from one department in the final year(s). To proceed to the following year, students generally need to have obtained at least 40% credit in the preceding year. If a student fails to pass a particular course, they may be allowed to resit, either in September or in the following year.

The marks from each year are accumulated over the three or four years of the degree to obtain a final mark. This is then used to decide the final degree classification. The marks from each year are weighted as follows:

Course	Year Weighting
BEng degree	1 : 2 : 3
MEng degree	1 : 2 : 2 : 4

A total of 180 ECTS points are awarded for the BEng degree and 270 ECTS points for the MEng degrees.

Year One

Maths courses

The first year JMC contains the following Maths courses. The assessment of these courses combines coursework, test and exam components. M1F and M1M1 are standard M1 maths courses. M1J1 and M1J2 are specific JMC courses given by the Maths department.

Code	Course	Term
M1F	Foundations of Analysis	1
M1M1	Mathematical Methods I	1
M1J1	Applied Methods and Linear Algebra	2
M1J2	Algebra and Analysis	2

Computing Courses

The first year JMC contains the following Computing courses:

Code	Course	Term
C120.1	Programming 1	1
C120.2	Programming 2	1—2
C140	Logic	1
C113	Architecture	2
C141J	Reasoning about Programs	2
C164	Ethics in Computing	2
C120.3	Programming 3	3
C173	Computer algebra lab/project	3
C176	Laboratory	1—3

Credit

Credit is awarded on the following basis:

Component	Credit percent
Four mathematics courses including coursework (each contributing 12.5%)	50
Three computing courses (each exam contributing 6%)	18
Computing coursework	3
Group Project	4
Programming	25
Total	**100**

Computing coursework to be made up from Computing courses with assessed courseworks and tests. Currently this comprises Architecture (47.5%), Logic (47.5%) and Ethics (5%).

The programming assessment consists of C120.1 (35%), C120.2 (45%) and C120.3 (20%).

ECTS Points

Module			
Name	ECTS	Taught Hours	Private Hours
CO113 Architecture	5.0	27	100
CO120.1 Programming I	5.5	20	120
CO120.2 Programming II	5.5	20	120
CO120.3 Programming III	5.0	20	120
CO140 Logic	5.0	27	100
CO141 Reasoning about programs (	5.0	27	100
CO141J Laboratory Work	3.0	15	73
CO164 Ethics in Computing	0.0	4	10
M1F Foundations of Analysis	6.5	40	122.5
M1J1 Applied Methods and Linear Algebra	6.5	40	122.5
M1J2 Algebra and Analysis	6.5	40	122.5
M1M1 Mathematical Methods I	6.5	40	122.5
	60.0	320	1233

Supplementary Qualifying Tests

At the discretion of the Examiners, Supplementary Qualifying Tests (SQTs) may be offered to a candidate who marginally fails to achieve the conditions laid down for a pass.

Year Two

Maths Courses

The second year JMC contains the following Maths courses:

Code	Course	Term
M2SJ	Statistical Methods	1
M2PM1	Real Analysis ^{x}	1
M2AA2	Multivariable Calculus ^{x}	1
M2AA3	Introduction to Numerical Analysis	2
M2PM3	Complex Analysis ^{y}	2
M2AM	Non-linear Waves ^{y}	2
M2S2	Statistical Modelling ^{y}	2

A total of 4 courses are selected. Courses marked with an x or y are optional as described below.

Statistical Methods (M2SJ) and Introduction to Numerical Analysis (M2AA3) are compulsory courses for all degrees. In term 1 one x-course, either Real Analysis (M2PM1) or Multivariable Calculus (M2AA2), is selected. In term 2, one y-course, Complex Analysis (M2PM3), Non-linear Waves (M2AM) or Statistical Modelling (M2S2), is selected.

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Students are advised that M2S2 is highly recommended if taking the MEng Computational statistics stream and M2PM1 and M2PM3 are highly recommended if taking the MEng Pure Maths and Logic stream. For students interested in more applied modules in later years, Multivariable Calculus and Non-linear Waves are recommended.

Note that, in JMC 3, you may choose up to two M2 courses from those offered by the Maths department if you have not already taken them in JMC 2 (including courses such as Algebra II and Metric Spaces & Topology that are not available in JMC 2).

Computing Courses

The second year JMC contains the following Computing courses:

Code	Course	Term
C220	Software Engineering - Design	1
C276	Prolog	1
C211	Operating Systems	2
C261J	Laboratory	1—2
C271	Computing Group project	3
C202	Software Engineering – Algorithms [a]	2
C275	C++ Introduction	1
C221	Compilers [a]	1
C223	Concurrency [a]	1
C231	Introduction to AI [a]	2
C240	Models of Computation [a]	1
C526	Databases [a]	2

In Computing for all degrees, the compulsory courses are:

Software Engineering - Design and Operating Systems with short courses Prolog (9 hours), C++ Introduction (6 hours), along with the JMC Lab and the Computing group project. Note that the HCD course (C203) is compulsory for all JMC2 students including assessments as it feeds directly into the Group projects in J MC 2 an d 3. The Group project may be taken in either Maths or Computing - selection of this happens in the Spring term.

Optional courses are marked with an 'a' above and students choose three from:

Software Engineering – Algorithms, Compilers, Concurrency, Introduction to AI, Models of Computation and Databases

Note that if a student is not able to take Concurrency, Databases or Models of Computation in the second year, then a version of these courses exists as an option in JMC 3, respectively C528, C526 and C240. It is not possible to take these subjects in both JMC2 and JMC3.**Credit**

Credit

Credit is awarded on the following basis:

Component	Credit percent	ECTS
Four mathematics exams (each contributing 12.125%, 7 ECTS)	48.5	28
Five computing exams + Coursework (each contributing 7%, 4 ECTS)	35	20
Computing laboratory + Prolog	12.5	12
Group Project	3	0
HCD	1	0
Total	**100**	**60**

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The Computing laboratory + Prolog assessment is currently made up of JMC2 Lab - XMC261J (85%), Team Skills Development - XC272 (1%) and Introduction to Prolog - C276 (14%).

Supplementary Qualifying Tests

At the discretion of the Examiners, Supplementary Qualifying Tests may be offered to a candidate who marginally fails to achieve the conditions laid down for a pass.

Please see JMC2 progression rules for a guide to progression to JMC3.

ECTS Credits

Module			
Name	**Credits**	**Taught Hours**	**Private Study Hours**
CO220 Software Engineering Design	4.0	27	73
CO275 C++ Introduction	0.0	12	4
CO276 Introduction to Prolog	3.0	12	63
CO272 Team Skills Development	0.0	13	12
CO211 Operating Systems	4.0	28	73
CO261 Laboratory 2	9.0	9	175
CO271 2nd Year Group Projects	0.0	20	60
CO203 Human-Centred Design	0.0	16	4
*CO202 Software Engineering - Algorithms	4.0	27	73
*M1S Probability and Statistics I	7.0	40	135
M2SJ Statistical Methods	7.0	40	135
M2AA3 Introduction to Numerical Analysis	7.0	40	135
*M2PM3 Complex Analysis	7.0	40	135
*CO221 Compilers	4.0	27	73
*CO231 Introduction to Artificial Intelligence	4.0	27	73
*CO526 Databases	4.0	27	73
*CO223 Concurrency	4.0	27	73
*CO240 Models of Computation	4.0	27	73
*M2S2 Statistical Modelling I	7.0	40	135
*M2PM1 Real Analysis	7.0	40	135
*M2PM5 Metric Spaces and Topology	7.0	40	135
	60.0	378.0	1223.0

Supplementary Qualifying Tests

At the discretion of the Examiners, Supplementary Qualifying Tests may be offered to a candidate who marginally fails to achieve the conditions laid down for a pass.

Year Three

Year 3 MEng consists of 8 courses, a compulsory group project in Computing and a compulsory industrial placement organised in Computing.

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Maths: At least 2 and at most 6 Mathematics courses are to be chosen from the overall list of courses which are made available. Up to two Maths options may be taken from M2 courses that were not taken during the second year. Note that M3 courses that also exist as M4 equivalents and are taken in the third year cannot also be taken as M4 courses in the fourth year.

Computing: At least 2 and at most 6 Computing courses are to be chosen from the overall list of courses which are made available.

The industrial placement runs from June to September.

One option may be an external course offered by the Imperial College Business School or the Humanities Department.

Credit

Component	Credit percent	ECTS
Eight course options (each contributing 10%, 6 ECTS)	80	48**
Group project	20	12
Industrial Placement	0	30*
Total	**100**	**90**

** ECTS points for the industrial placement are awarded on passing of the year*
*** The ECTS points for these entries are not awarded on an individual basis on completing these components but are awarded in aggregate on passing the year.*

Progression Requirements

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

1. Achieved at least 40% in the Group project
2. Achieved at least 40% overall for the year

Failure in the group project component of the course (Autumn term of 3rd year) will ordinarily lead to discussion about transfer to the BEng degree for the remainder of the third year.

ECTS Credits

Module				
Name	**Credits**	**Hours**	**Hours**	**Hours**
CO302 Software Engineering Practice with CO362 Group Project	12.0	36	300	0
$Industrial Placement & Preparation	30.0	2	0	1250
*CO333 Robotics	6.0	27	140	0
*CO526 Databases	6.0	27	140	0
*M3S1 Statistical Theory I	6.0	30	140	0
*M3S11 Games, Risks & Decisions	6.0	30	140	0
*CO317 Graphics	6.0	27	140	0
*CO343 Operations Research	6.0	27	140	0
*CO341 Introduction to Bioinformatics	6.0	27	140	0
*M3P17 Algebraic Combinatorics	6.0	30	140	0
*CO347 Distributed Algorithms	6.0	27	140	0
*CO337 Simulation and Modelling	6.0	27	140	0

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*M3P11 Galois Theory	6.0	30	140	0
*CO395 Machine Learning	6.0	27	140	0
*CO528 Concurrent Programming	6.0	27	140	0
*M3P14 Number Theory	6.0	30	140	0
*M2PM1 Real Analysis	6.0	30	140	0
*M2PM3 Complex Analysis	6.0	30	140	0
*M2PM5 Metric Spaces and Topology	6.0	30	140	0
*CO330 Network Security	6.0	27	140	0
*CO332 Advanced Computer Architecture	6.0	27	140	0
*M2S1 Probability and Statistics II	6.0	30	140	0
*M3S4 Applied Probability	6.0	30	140	0
*M3S9 Stochastic Simulation I	6.0	30	140	0
*CO312 Advanced Databases	6.0	27	140	0
*CO316 Computer Vision	6.0	27	140	0
*M2S2 Statistical Modelling I	6.0	30	140	0
*M3M6 Methods of Mathematical Physics	6.0	30	140	0
*CO382 Type Systems for Programming Languages	6.0	27	140	0
*M3P15 Algebraic Number Theory	6.0	30	140	0
*M3P16 Analytic Number Theory	6.0	30	140	0
*M3S2 Statistical Modelling II	6.0	30	140	0
*M3S7 Statistical Pattern Recognition	6.0	30	140	0
*M3SC Scientific Computation	6.0	30	140	0
*M3T Communicating Mathematics	6.0	30	140	0
*M2AA1 Differential Equations	6.0	30	140	0
*M2AA2 Multivariable Calculus	6.0	30	140	0
*M2AA3 Introduction to Numerical Analysis	6.0	30	140	0
*CO318 Custom Computing	6.0	27	140	0
*CO320 Complex Systems	6.0	27	140	0
*CO322 Communicating Computer Science in Schools	6.0	27	140	0
#BS0808 Finance & Finance Management	6.0	30	120	0
*M3A22 Mathematical Finance: a journey in Stochastic Analysis	6.0	30	140	0
*M3H History of Mathematics	6.0	30	140	0
*CO350 Management and Business for Computing Engineers	6.0	27	140	0
*M3M3 An introduction to partial differential equations	6.0	30	140	0
*M3M7 Asymptotic Analysis	6.0	30	140	0
*M3N10 Computational Partial Differential Equations I	6.0	30	140	0
*M3N7 Numerical Solution of Ordinary Differential Equations	6.0	30	140	0
*M3P10 Group Theory	6.0	30	140	0
*M3P12 Group Representation Theory	6.0	30	140	0
*CO484 Quantum Computing	6.0	27	140	0

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*CO527 Computer Networks and Distributed Systems	6.0	27	140	0
*M3P18 Fourier Analysis & Theory of Distributions	6.0	30	140	0
*M3P19 Measure & Integration	6.0	30	140	0
*M3P20 Geometry I: Algebraic Curves	6.0	30	140	0
*M3P21 Geometry II: Algebraic Topology	6.0	30	140	0
*M3P23 Computational Algebra & Geometry	6.0	30	140	0
*M3PA23 Dynamical Systems	6.0	30	140	0
*M3PA24 Bifurcation Theory	6.0	30	140	0
*M3PA46 Chaos and Fractals	6.0	30	140	0
*M3S14 Survival Models and Actuarial Applications	6.0	30	140	0
*M3S16 Credit Scoring I	6.0	30	140	0
*M3S17 Credit Scoring II	6.0	30	140	0
*M3S8 Time Series	6.0	30	140	0
#Design-led Innovation and New Venture Creation	6.0	27	140	0
	90.0	263.0	1420.0	1250.0

Progression Requirements

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

1. Achieved at least 40% in the Group project
2. Achieved at least 40% overall for the year

Failure in the group project component of the course (Autumn term of 3rd year) will ordinarily lead to discussion about transfer to the BEng degree for the remainder of the third year.

Year Four

Students must take a total of 7 course options, of which at least 2 must be chosen from Computing and at least 2 from Mathematics. One of the options may be a Humanities course from a specified list. Students on the IG11 degree must offer at least two pure maths options from a specified list of M4P courses. Students on the GI43 degree must offer at least two statistics options from a specified list of M4S courses.
There is an additional compulsory individual project in either Computing or Mathematics. Each course, except the project, comprises examination and coursework.
Coursework normally contributes 10% to each Mathematics course. Mathematics M3 options chosen in the Fourth Year must be offered as an M4 version with an additional mastery examination comprising between 2 and 5 master's level questions. The mastery paper contributes 15% to each Mathematics course.

Each course comprises examination and coursework. In Mathematics, coursework normally [some are assignment only] contributes 10% to each Mathematics course. In Computing, coursework is normally weighted as one-seventh of the examination/coursework contribution for each Computing course.
To pass the seven courses, an average of 40% is required. To pass the individual project element, 40% is required.

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Credit

Component	Credit
Seven course options (each contributing 10%)	70
Industrial placement	2.5
Individual project	27.5
Total	**100**

** ECTS points for the industrial placement are awarded on passing of the year*
*** The ECTS points for these entries are not awarded on an individual basis on completing these components but are awarded in aggregate on passing the year.*

ECTS Credits

Module			
Name	**Credits**	**Taught Hours**	**Private Study Hours**
CO464 Industrial Presentation and Report	2.0	0	50
CO401J Individual Project	18.0	24	500
*CO422 Computational Finance	6.0	27	140
*CO499 Modal and Temporal Logic	6.0	27	140
*M4P5 Geometry of Curves and Surfaces with Advanced Study	6.0	30	140
*CO438 Complexity	6.0	27	140
*CO475 Network Security	6.0	27	140
*M4P17 Algebraic Combinatorics with Advanced Study	6.0	30	140
*M4P46 Lie Algebras	6.0	30	140
Y3 Placement ASSESSMENT	50.0	0	0
*CO312 Advanced Databases	6.0	27	140
*CO316 Computer Vision	6.0	27	140
*CO317 Graphics	6.0	27	140
*CO320 Complex Systems	6.0	27	140
*CO322 Communicating Computer Science in Schools	6.0	27	140
* CO331 Network and Web Security	6.0	27	140
*CO332 Advanced Computer Architecture	6.0	27	140
*CO343 Operations Research	6.0	27	140
*CO347 Distributed Algorithms	6.0	27	140
*CO382 Type Systems for Programming Languages	6.0	27	140
*CO395 Machine Learning	6.0	27	70
*#CO404H Separation Logic: Local Reasoning about Programs	6.0	13.5	70
*#CO405H Computing in Space with OpenSPL	6.0	13.5	70
*#CO406H Concurrent Processes	6.0	13.5	70
*#CO407H Medical Image Computing	6.0	13.5	70
*#CO408H Privacy Enhancing Techniques	6.0	13.5	70
*CO409 Cryptography Engineering	6.0	27	140
*#CO410H Scalable Distributed Systems Design	6.0	13.5	70

*CO417 Advanced Computer Graphics	6.0	27	140
*CO421 Computational Neurodynamics	6.0	27	140
*CO422 Computational Finance	6.0	27	140
*CO424 Machine Learning and Neural Computation	6.0	27	140
*CO429 Parallel Algorithms	6.0	27	140
*#CO436H Performance Analysis	3.0	13.5	70
*CO438 Complexity	6.0	27	140
*CO440 Software Reliability	6.0	27	140
*CO470 Program Analysis	6.0	27	140
*CO471 Advanced Issues in Object Oriented Programming	6.0	27	140
*CO474 Argumentation and Multi-agent Systems	6.0	27	140
*CO475 Software Engineering for Industry	6.0	27	140
*CO477 Computing for Optimal Decisions	6.0	27	140
*CO491 Knowledge Representation	6.0	27	140
*CO493 Intelligent Data and Probabilistic Inference	6.0	27	140
*CO495 Advanced Statistical Machine Learning and Pattern Recognition	6.0	27	140
*#CO499H Modal Logic	3.0	13.5	70
#BS0815 Business Economics	6.0	27	140
*M3E Econometric Theory and Methods	6.0	30	140
*M4A21 Mathematical Biology I: Molecular Topology and Stereochemistry	6.0	30	140
*M4A22 Mathematical Finance: An Introduction to Option Pricing	6.0	30	140
*M4A42 Applied Stochastic Processes	6.0	30	140
*M4A44 Computational Stochastic Processes	6.0	30	140
*M4N10 Computational Partial Differential Equations I	6.0	30	140
*M4N7 Numerical Solution of Ordinary Differential Equations	6.0	30	140
*M4P10 Group Theory	6.0	30	140
*M4P11 Galois Theory	6.0	30	140
*M4P12 Group Representation Theory	6.0	30	140
* M4P14 Number Theory	6.0	30	140
*M4P15 Algebraic Number Theory	6.0	30	140
*M4P16 Analytic Number Theory	6.0	30	140
*M4P7 Functional Analysis with Advanced Study	6.0	30	140
*M4P8 Algebra III with Advanced Study	6.0	30	140
*M4S14 Survival Models and Actuarial Applications with Advanced Study	6.0	30	140
*M4P17 Algebraic Combinatorics	6.0	30	140
*M4P18 Fourier Analysis & Theory of Distributions	6.0	30	140
*M4P19 Measure & Integration	6.0	30	140
*M4P20 Geometry I: Algebraic Curves	6.0	30	140
*M4P21 Geometry II: Algebraic Topology	6.0	30	140
*M4P23 Computational Algebra & Geometry	6.0	30	140
*M4P32 Number Theory: Elliptic Curves	6.0	30	140
*M4P34 Groups and Representations	6.0	30	140
*M4P36 Representations of Symmetric Groups	6.0	30	140

*M4P41 Analytic Methods in Partial Differential Equations	6.0	30	140
*M4P46 Lie Algebras	6.0	30	140
*M4P5 Geometry of Curves and Surfaces	6.0	30	140
*M4P51 Riemannian Geometry	6.0	30	140
*M4P52 Manifolds	6.0	30	140
*M4P54 Differential Topology	6.0	30	140
*M4P55 Commutative Algebra	6.0	30	140
*M4P57 Complex Manifolds	6.0	30	140
*M4P6 Probability Theory	6.0	30	140
*M4P7 Functional Analysis	6.0	30	140
*M4P8 Algebra III	6.0	30	140
*M4S1 Statistical Theory I	6.0	30	140
*M4S11 Games, Risks & Decisions	6.0	30	140
*M4S14 Survival Models and Actuarial Applications	6.0	30	140
*M4S16 Credit Scoring I	6.0	30	140
*M4S17 Credit Scoring II	6.0	30	140
*M4S2 Statistical Modelling II	6.0	30	140
*M4S4 Applied Probability	6.0	30	140
*M4S7 Statistical Pattern Recognition	6.0	30	140
*M4S8 Time Series	6.0	30	140
*M4S9 Stochastic Simulation I	6.0	30	140
*M4SC Scientific Computation	6.0	30	140
	62.0	222.0	1530.0

Courses numbers that end in H are half courses. Students are required to take to two of these to achieve one full course credit.

18. Support provided to students to assist learning (including collaborative students, where appropriate).

- Before students arrive to start the degree programme they receive academic and other advice about their induction into the two departments.
- On arrival students receive a course document (green), which details necessary information about their courses together with a timetable. They also receive a “Freshers’ Handbook” and other general information about safety, Libraries, computing and other facilities.
- Students in the first year have a one-week orientation at the beginning of the Autumn Term, during which they have an introduction to the Departments, to the libraries, to personal tutors, to the degree programme, and a diagnostic test in Mathematics.
- All students have access to extensive library facilities including the College facilities and the Departments’ libraries on-site.
- Students of all years have access to detailed course documents, both in hard copy and on the Web, about course descriptions and assessments. The JMC web-based documentation gives details of courses available, their syllabuses and a guide to completing project work.
- In their first year students are allocated a personal tutor, a personal maths tutor and a personal computing tutor. The tutors’ role is to assist their tutees with personal problems and to advise students on academic issues that may arise during the course of their degree. The role of the computing and maths tutors is to provide a continuous monitoring of students’ academic progress and to pinpoint areas of difficulty that students from a vast range of academic backgrounds experience may encounter in their first year of the course.

- All students have email and open personal access to their tutorial support, including the year co-ordinators, Senior Tutors and the Directors of Studies.
- All students have access to student counsellors on-site.
- Elected student Undergraduate Representatives (one for each of the three years) and the departmental student Representative meet with academics at the staff-student Committee three times a year to discuss issues relating to their study. The Representatives also meet with the JMC coordinator as and when problems arise. In addition, the departmental student Representative sits in on the Academic Committee, which meets once a month.
- All students have access to Teaching and Learning Support Services, which provide assistance and guidance, e.g. on careers, and to state-of-the-art Computing facilities, in both Departments. The stock is regularly upgraded and the scheduled lab sessions have lab staff to assist with technical queries.
- An undergraduate handbook is also available in the libraries, with descriptions of every course available on the programme.
- All students have access to the Internet and to Departmental Web pages which include examination and lecture timetables, an online computing dictionary, links to careers and the main college website.
- There are extensive library facilities in Mathematics and in Computing in the Main College library. There is an excellent supply of books and resource materials. The new Mathematics Learning Centre offers also a good working environment for private study.
- Employer needs and opinions feed into the programme through frequent guest lectures and seminars from industry, industry based group and individual projects and collaboration between staff and industry in research and consultancy. The Departments' student societies (DocSoc and MathSoc) regularly invite guest speakers from industry to discuss career, technical issues and topics of general mathematical interest.

Other facilities include:

- A Student Common Room in both Mathematics and Computing Departments.
- Open access to the Senior Tutors and Directors of Studies in both Mathematics and Computing.
- MathSoc and DocSoc – societies for all members of the two Departments for academic and non-academic events.
- PLUS! a group for those (students and staff) interested in 'non-standard' problem solving.
- Careers advice within the Departments as well as College Careers Service.
- Access to student counsellors on the South Kensington site and a Health Centre.
- Access to a Union advisor.
- Access to College Teaching and Learning Support Services.

19. Criteria for admission:

The minimum entry requirements for the MEng courses are three A levels, including:

Grade A* in Mathematics
Grade A* in Further Mathematics
Grade A in one other subject
These grades are the norm, but may be varied occasionally by the admissions tutors

Applications from individuals with equivalent non-GCE qualifications, such as Scottish Advanced Highers, International, French and European Baccalaureates are also considered.

20. Processes used to select students:

- Primarily UCAS application, Examination Grades and Interview
  - Substantial importance is placed on the motivation for taking a demanding joint degree programme and this is looked for in the UCAS application and at interview
  - Substantial importance is placed on the work ethic and time management skills and this is looked for in the UCAS application and at interview
  - Substantial importance is placed on the potential to succeed in such a degree (even where GCSE results, for instance, have not been outstanding) and this is looked for in the UCAS application and at interview. Usually this consists of the assessment of technical questions designed to demonstrate innate ability rather than raw knowledge of the subject.
  - For overseas students who may not attend a physical interview, a telephone interview and written assessment test may be used

- The interview day consists of:
  - a welcome presentation by the Admissions tutor and Director of Studies
  - a tour of the College and Department facilities
  - demonstrations of undergraduate projects
  - a one-to-one academic interview with one of our lecturers

21. Methods for evaluating and improving the quality and standards of teaching and learning

a) Methods for review and evaluation of teaching, learning, assessment, the curriculum and outcome standards:

- Individual course review initiated through the Directors of Undergraduate Studies.
- Annual course review through the Departmental Examinations Committees.
- Regular reports on the different programmes by the various Course Directors and year Co-ordinators submitted to the monthly meetings of the Academic Committees.
- Feedback from students both at the Staff-Student Committee meetings and through lecture evaluation questionnaires filled in by the students.
- Feedback from Peer Review of Teaching to check for adequate coverage of material in given subject areas.
- Reports from External Examiners commenting on the range of subjects covered and the standard achieved.
- Reports from alumni on the relevance of material taught to their professional work.
- Biennial staff appraisal.
- Periodic review of Departmental teaching by the College's Engineering Studies Committee and Science Studies Committee.

The external examiner system and Boards of Examiners are central to the process by which the College monitors the reliability and validity of its assessment procedures and academic standards. Boards of Examiners comment on the assessment procedures within the College and may suggest improvements for action by relevant departmental teaching Committees.

The Faculty Studies Committees and the Graduate Schools' Postgraduate Quality Committees review and consider the reports of external examiners and accrediting bodies and conduct periodic (normally quinquennial) and internal reviews of teaching provision. Regular reviews ensure that there is opportunity to highlight examples of good practice and ensure that recommendations for improvement can be made.

At programme level, the Head of Department/Division has overall responsibility for academic standards and the quality of the educational experience delivered within the department or division.

Most of the College's undergraduate programmes are accredited by professional engineering and science bodies or by the General Medical Council. Accreditation provides the College with additional assurance that its programmes are of an appropriate standard and relevant to the requirement of industry and the professions. Some postgraduate taught courses are also accredited.

b) Committees with responsibility for monitoring and evaluating quality and standards:

- Departmental Academic Committees.
- Departmental Undergraduate Course/Teaching Strategy Committees.
- Departmental Staff Meetings.
- Departmental Examination Committees.
- Departmental Management Committees.
- Joint Undergraduate Staff-Student Committee.
- Board of Examiners - meets in July to consider awards.
- Faculty of Science and Faculty of Engineering Teaching Committees
- Imperial College Quality Assurance Advisory Committee
- Imperial College Senate

The **Senate** oversees the quality assurance and regulation of degrees offered by the College. It is charged with promoting the academic work of the College, both in teaching and research, and with regulating and supervising the education and discipline of the students of the College. It has responsibility for approval of changes to the Academic Regulations, major changes to degree programmes and approval of new programmes.

The **Quality Assurance Advisory Committee** (QAAC) is the main forum for discussion of QA policy and the regulation of degree programmes at College level. QAAC develops and advises the Senate on the implementation of codes of practice and procedures relating to quality assurance and audit of quality and arrangements necessary to ensure compliance with national and international standards. QAAC also considers amendments to the Academic Regulations before making recommendations for change to the Senate. It also maintains an overview of the statistics on completion rates, withdrawals, examination irregularities (including cases of plagiarism), student appeals and disciplinaries.

The **Faculty Studies Committees** and **Graduate School Postgraduate Quality Committees** are the major vehicle for the quality assurance of undergraduate / postgraduate courses respectively. Their remit includes: setting the standards and framework, and overseeing the processes of quality assurance, for the areas within their remit; monitoring the provision and quality of e-learning; undertaking reviews of new and existing courses; noting minor changes in existing programme curricula approved by Departments; approving new modules, changes in module titles, major changes in examination structure and programme specifications for existing programmes; and reviewing proposals for new programmes, and the discontinuation of existing programmes, and making recommendations to Senate as appropriate.

The **Faculty Teaching Committees** maintain and develop teaching strategies and promote inter-departmental and inter-faculty teaching activities to enhance the efficiency of teaching within Faculties. They also identify and disseminate examples of good practice in teaching.

Departmental Teaching Committees have responsibility for the approval of minor changes to course curricula and examination structures and approve arrangements for course work. They also consider the details of entrance requirements and determine departmental postgraduate student numbers. The Faculty Studies Committees and the Graduate School Postgraduate Quality Committees receive regular reports from the Departmental Teaching Committees.

c) Mechanisms for providing prompt feedback to students on their performance in course work and examinations and processes for monitoring that these named processes are effective:

Extensive programme of Assessed Coursework/Tests/Computational and Programming Assignments in both Departments. Written feedback and an oral presentation. All monitored and subject to moderation.

d) Mechanisms for gaining student feedback on the quality of teaching and their learning experience and how students are provided with feedback as to actions taken as a result of their comments:

- Lecturer evaluation questionnaires.
- Undergraduate Staff-Student Committee held each term - feedback from this is passed on to the Academic Committee.
- Meetings with personal tutees.
- Regular meetings between student representatives and JMC course director.
- Meetings with Personal tutors, Senior Tutors and Directors of Undergraduate Studies.

e) Mechanisms for monitoring the effectiveness of the personal tutoring system:

Feedback via Senior Tutors/Coordinators/Reports/JMC Staff-Student Committee

f) Mechanisms for recognising and rewarding excellence in teaching and in pastoral care:

Staff are encouraged to reflect on their teaching, in order to introduce enhancements and develop innovative teaching methods. Each year College and Faculty awards are presented to academic staff for outstanding contributions to teaching, pastoral care or research supervision. A special College award for Teaching Innovation, available each year, is presented to a member of staff who has demonstrated an original and innovative approach to teaching. Nominations for these awards come from across the College and students are invited both to nominate staff and to sit on the deciding panels.

g) Staff development priorities for this programme include:

- Active research programme in multiple fields of Computing and Mathematics.
- During probation, lecturers attend a series of College organised workshops on teaching and learning.
- Probationary Lecturers are assigned a mentor.
- Staff are appraised, approximately biennially.
- Staff have available to them courses and occasional seminars on teaching and learning provided by the College Staff Development Programmes (i.e. CASLAT).
- Updating professional developments.

22. Regulation of Assessment

a) Assessment Rules and Degree Classification:

- The marks from each discipline (Mathematics and Computing) are aggregated each year with the years combined to give one final mark. These are then used to decide the final degree classification (see summary below for MEng degree classification).
- For each Mathematics course, (honours) marks are awarded on a 0-100 College scale with fixed points at 0,40 (for Third), 50, 60 (lower/upper second class boundary), 70 (for lowest 1st class), 100 (nominated maximum marks).
- In Mathematics, assessed coursework, where relevant, normally contributes 10% to each course.
- For each Computing written examination, marks are awarded on a 0-60 scale. The pass mark for each written examination is 40%.
- In Computing, assessed coursework is usually weighted as one-seventh of the examination/coursework contribution for each Computing course.
- Students who pass all course elements over the three years will be awarded an Honours degree classified as First, Second (upper and lower division) or Third. There is no Pass degree category.
- The marks for each year are weighted as follows:

  Year Honours Weighting: 1 : 2 : 2 : 4
- The final Honour assessment is based on the total marks after the corresponding year weighting has been applied and by consideration across Mathematics and Computing overall.
- Summary of grades, marks and their interpretation for MEng degree classification [College Scale]

GRADE	MARKS	INTERPRETATION
A	70% - 100%	Marks represent a first class degree
B	60% - 69%	Marks represents a 2:1 degree
C	50% - 59%	Marks represent a 2:2 degree
D	40% - 49%	Marks represent a third class degree
E	0% -39%	Marks normally represent a fail

"Borderline" cases are discussed individually at the JMC Examiners Meeting on the basis of the full spectrum of academic performance during the programme.

b) Marking Schemes for undergraduate and postgraduate taught programmes:

On the College Scale, the Pass Mark for all **undergraduate** modules is 40%. From October 2008 entry all undergraduates are required to pass all their course elements in order to progress to the next year.

c) Processes for dealing with mitigating circumstances:

For undergraduate programmes: Candidates with mitigating circumstances are not subject to the borderline restrictions but should be considered individually. However, as a general principle, candidates whose marks are more than 5% below the borderline should not normally be raised to the next higher classification.

Resit opportunities are available for students who do not achieve a Pass in examinations – according to College rules.

Applications for such to be 'First attempts' normally on medical grounds - must be accompanied by a medical certificate or other statement of the grounds on which the application is made These shall be submitted to the Academic Registrar who will submit them to the Board of Examiners. A similar process applies for Appeals against other decisions of the Board of Examiners.

d) Processes for determining degree classification for borderline candidates:

For **undergraduate programmes**: Candidates who fall no more than 2.5% below the minimum mark for a higher honours classification shall be eligible for review of their final classification; this review could include an oral examination or practical test or other mechanism appropriate to the discipline. Candidates whose marks are below the 2.5% borderline may be considered for a higher honours classification where certain provisions apply. Where the Board of Examiners determines that a candidate should be awarded a higher honours classification extra marks should be applied to bring their final marks into the higher range. Detailed records of all decisions should be recorded in the minutes of the meeting of the Board.

e) Role of external examiners:

Two external examiners (from other universities in the UK) are nominated by the chairperson of the Board of Examiners and approved by the Science Studies Committee. External examiners normally serve 4 years. The role of the examiner is that of moderator. In order to do this, they normally:

- approve examination papers.
- review all continuous assessment (Courseworks, laboratory work, group projects).
- review all examination scripts.
- review all individual project dissertations.
- attend the Board of Examiners.
- complete a report to the college**.**

The primary duty of external examiners is to ensure that the degrees awarded by the College are consistent with that of the national university system. External examiners are also responsible for approval of draft question papers, assessment of examination scripts, projects and coursework (where appropriate) and in some cases will attend *viva voce* and clinical examinations. Although external examiners do not have power of veto their views carry considerable weight and will be treated accordingly. External examiners are required to attend each meeting of the Board of Examiners where recommendations on the results of individual examinations are considered. External examiners are required to write an annual report to the Rector of Imperial College which may include observations on teaching, course structure and course content as well as the examination process as a whole. The College provides feedback to external examiners in response to recommendations made within their reports.

23. Indicators of Quality and Standards

- Favourable comments by External Examiners

- High proportion of students achieving a high degree classification
- Favourable comments from the students.
- Recognition amongst employers.
- Recognition and high profile of the course amongst applicants (as judged by the large number of applicants and their quality).
- Professional accreditation – partial Chartered Engineer status
- First destination data for MEng graduates, indicating a high proportion find employment or further postgraduate training in related areas
- External College-invited course reviews
- Best graduating projects win National recognition and awards

24. Key sources of information about the programme can be found in

- Mathematics and Computer Science resources page – available at:
  www.doc.ic.ac.uk/go/jmc
- Undergraduate Prospectus, Imperial College London – available on-line at:
  www.imperial.ac.uk
- Undergraduate Study in Computing at Imperial College – available on-line at: www3.imperial.ac.uk/computing/teaching/
- ECTS assignment for BEng/MEng degrees – available on-line at:
  http://www3.imperial.ac.uk/computing/teaching/ug/jmc/regulations
- Mathematics Undergraduate Courses – available on-line at
  http://www3.imperial.ac.uk/mathematics/students/undergraduate/courseguides
- Mathematics: Scheme for the Award of Honours – available on-line at:
  http://www3.imperial.ac.uk/mathematics/students/undergraduate/programspecifications
- Computing: Scheme for the Award of Honours – available on-line at:
  http://www3.imperial.ac.uk/computing/teaching/prog-spec