

Programme Information		
Programme Title	Programme Code	HECoS Code
Computing (Visual Computing and Robotics)	GG47	For Registry Use Only

Award	Length of Study	Mode of Study	Entry Point(s)	Total Credits	
				ECTS	CATS
MEng	4 years	Full time	October	270	540
BEng (Hons)	3 years	Full time	*none (exit award only)	180	360
BEng (Ordinary)	3 years	Full time	*none (exit award only)	150	300
DipHE	2 years	Full time	*none (exit award only)	120	240
CertHE	1 year	Full time	*none (exit award only)	60	120

Please refer to the Progression and Classification section at the end of this document for information on transferring between Computing degree programmes.

*Please note: Only the MEng degree is accredited. The BEng, DipHE and CertHE exit awards are unaccredited. The BEng exit award is different to the BEng for entry award, which is accredited. Please refer to the separate Computing BEng programme specification for this degree programme for further details.

Ownership			
Awarding Institution	Imperial College London	Faculty	Faculty of Engineering
Teaching Institution	Imperial College London	Department	Computing
Associateship	City and Guilds of London Institute (ACGI)	Main Location(s) of Study	South Kensington Campus
External Reference			
Relevant QAA Benchmark Statement(s) and/or other external reference points		http://www.qaa.ac.uk/docs/qaa/subject-benchmark-statements/sbs-computing-16.pdf	
FHEQ Level		Level 7 - Master's	
EHEA Level		2nd Cycle	
External Accreditor(s) (if applicable)			
External Accreditor 1:	BCS - Chartered Institute for IT		
Accreditation received:	2017	Accreditation renewal:	2020

External Accreditor 2:	Institute of Engineering and Technology		
Accreditation received:	2017	Accreditation renewal:	2020
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. Tony Field	
Student cohorts covered by specification		2020-21 entry	
Date of introduction of programme		September 19	
Date of programme specification/revision		December 20	

Programme Overview
<p>Our Computing degree programmes are designed to ensure that you will have detailed exposure to both the theoretical and practical aspects of Computing. At Imperial we see Computing as an engineering discipline where the emphasis is on building complex computer-based systems that work and are fit for purpose. The Visual Computing and Robotics specialism will give you a deep understanding of state-of-the-art methods in the design, implementation and evaluation of systems that depend on computer vision and/or computer-generated imagery. Specific application areas include robotic and autonomous systems, medical imaging and visual effects.</p> <p>By choosing this specialism you will take a number of compulsory modules¹ that will give you a deep understanding of state of the art methods, including computer vision and machine learning, in the design, implementation and evaluation of robotic and autonomous systems.</p> <p>In the first two years, there is a carefully planned programme of practical laboratory work where you will solve problems of gradually increasing size and complexity. Each problem is designed to teach a specific aspect of Computing and, at the same time, provide exposure to a range of software and hardware platforms and tools appropriate to the problem. The emphasis throughout is on instilling transferable problem-solving skills and independent learning, rather than on the teaching of specific technologies.</p> <p>The mathematical foundations of computing, which includes various topics in discrete and continuous mathematics, is taught through a series of core modules in the first two years. Follow-on modules in the third and fourth years allow you to apply the knowledge and skills gained to build and reason about complex systems, with key drivers being correctness, usability, security, reliability and performance.</p> <p>In the third year you will undertake a group project, which will provide you with experience of what it's like to work as part of a team. You will also have the opportunity to work with external companies and collaborators as part of the project.</p> <p>At the end of the Spring term of the third year you will embark on a full-time, paid industrial placement which finishes just prior to the start of the final year.</p> <p>In the final year you will undertake a major individual project spanning around eight months. This presents an exciting opportunity for you to apply the technical skills you have learnt throughout the course, including</p>

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.

research and presentation skills, under the supervision of an academic adviser. The topics covered by individual projects vary enormously, from the very theoretical to the very practical. Many projects are aligned directly with the Department's cutting-edge research activities.

Students graduate with exceptional practical skills and with the ability to apply their extensive knowledge of key Computing principles to the engineering of complex systems that are fit for purpose, and also to academic and industrial research.

BEng vs MEng

The department offers both a three-year BEng programme and four-year integrated Master's MEng programme in Computing. Both degree programmes involve substantial group and individual project work. The MEng programme has the added benefit of an industrial placement, and in your final year of your programme you will be able to choose from a range of Master's level elective modules and gain further exposure to cutting-edge research problems in computing.

Benefits of accreditation

The programme is professionally accredited by the IET (Institution of Engineering and Technology) and the BCS (the Chartered Institute for IT).

Achieving a professionally accredited integrated Master's degree (MEng) means that you have satisfied the first step to becoming a Chartered Engineer (CEng) in your chosen field by satisfying the educational requirements of professional registration. To gain Chartered status, you will need to demonstrate your ability to meet additional graduate level competences described in the Engineering Council's UK-SPEC

A CEng is a highly respected qualification earned by professionals working in engineering, which can lead to higher earning potential and better career prospects.

Professional registration also brings international recognition of your qualification, which is particularly useful for students preparing for a career abroad.

Learning Outcomes

Upon successful completion of the programme a typical student will be able to:

On completion of year 1 (equivalent to a Cert HE) ...

1. Explain the internal architecture of a simple computer.
2. Develop and test software solutions to well-specified problems using a variety of programming paradigms.
3. Describe the key characteristics of information systems and use such systems effectively for data storage and retrieval.
4. Use mathematical methods to specify and analyse the behaviour of simple programs.
5. Use continuous mathematics to solve simple problems in applied Computing.
6. Apply basic research methods and communicate findings orally and in writing.
7. Explain the social, ethical and professional principles associated with computer-based technology and act in a manner that respects those principles.

On completion of year 2 (equivalent to a Dip HE), the ILOs above and...

8. Apply software engineering design principles to the development of robust software that is easy to understand, test and maintain.
9. Design, implement and deploy web-based applications that meet the needs of their target users.
10. Specify, design and implement programming languages.
11. Explain the key principles underpinning the design of modern computer and communication systems.
12. Describe formal computational models that underpin Computing and use these to explain the limitations of computers.
13. Explain the relevant laws that impact on the practice of computing.

On completion of the third year, all the ILOs above and...

14. Design, engineer and extend complex computer-based systems that are fit for purpose using core Computing knowledge and appropriate state-of-the-art technology, methods and thinking.
15. Develop computer-based systems in a manner that respects relevant legal, social, ethical and other professional practices.
16. Select and apply appropriate methods, techniques and tools to ensure correctness, security, reliability, performance, and maintainability of computer-based systems.

17. Apply mathematical methods and scientific reasoning to novel computing-related problems.
18. Demonstrate effective teamwork in the management and delivery of complex projects.
19. Communicate effectively, both orally and in writing, as individuals and as part of a team.

On achieving the MEng, all the ILOs above and...

20. Apply technical knowledge and expertise to cutting-edge problems in industry.
21. Reflect critically on professional practice in an industrial setting.
22. Individually demonstrate the cutting-edge research, methods and thinking to solve complex Computing problems in scientific, engineering and industrial domains.
23. Employ state of the art machine learning algorithms, libraries and tools to complex vision, control and planning problems.
24. Design, build and experiment with practical hardware, including self-moving devices, cameras, actuators and sensors.

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	<p>A-levels</p> <p>Our typical A-level offer is A*AA - A*AAA with an A* in Maths. Typical offers also require STEP I/II.</p> <p>For further recommendations on A-levels, see the tab on Qualification Advice for Computing. We strongly encourage applicants to take Further Maths at A2 level.</p> <p>We also accept the Edexcel International A levels.</p> <p>International Baccalaureate</p> <p>Our typical IB offer is 42–44 points overall with a 7 in Maths at higher level and a 7 in at least one further relevant subject at higher level. Typical offers also require STEP I/II.</p> <p>For further information on entry requirements, please go to https://www.imperial.ac.uk/study/ug/apply/requirements/ugacademic/ and the Department's admission pages at https://www.imperial.ac.uk/computing/prospective-students/courses/ug/beng-meng-computing/</p>
Non-academic Requirements	N/A
English Language Requirement	<p>Standard requirement</p> <p>Please check for other Accepted English Qualifications</p>
Admissions Test/Interview	<p>All students are required to take an on-line admissions test that can be sat at various times throughout the admissions cycle. Applicants who are shortlisted will be invited for interview. This will normally be held at Imperial College, although there is provision for interviews to be conducted on-line.</p>

The programme's competency standards documents can be found at:

<http://www.imperial.ac.uk/computing/prospective-students/courses/competence/>

Learning & Teaching Approach

Teaching

You will be taught through a combination of lectures, small-group and class-based tutorials, practical laboratory sessions and personal supervision of project work.

The first two years of the programme is made up of core modules. In year 1 the programming and various mathematics modules are backed up with small group tutorials in groups of approximately eight students. A senior undergraduate student will act as an Undergraduate Teaching Assistant for many of these tutorials.

The third and fourth years comprise a mixture of compulsory and elective taught modules. In the third year you will also undertake a group project where you will develop a complex application as part of a team of around six students. The ability to work effectively in teams is an essential skill for any aspiring engineer and Computing is no exception.

In the fourth year you will undertake a substantial individual project under the supervision of a member of staff. These require you to use the skills you have learnt to develop a novel piece of software, hardware or theory, often related to a topical research problem in Computing.

There is a spine of professional and transferable skills throughout the four years which includes training in oral and written communication skills and group working, and exposure to important ethical and legal frameworks that will help to govern your activities as a practicing engineer. Your ability to communicate orally and in writing will be assessed as part of various group and individual project activities throughout the degree. When developing software systems in years 2 and beyond you will be expected to conform to relevant computer law, for example relating to software licencing and the use of personal data, and this will also form part of the assessment.

The teaching methods will vary from standard classroom teaching to more active learning, where much of what you learn will be by small-group discussions and in-class problem-solving.

Independent learning

You will be expected to spend significant time on independent study outside of face to face contact time. This will typically include reading journal articles and books, undertaking research on-line and in the library, reviewing lecture notes and watching lecture recordings, working on individual and group projects, working on coursework assignments and revising for exams. There is also a programme of extra-curricular lectures delivered by guest speakers from industry designed to introduce you to some of the key technical challenges in Computing that are being faced by industry.

Industrial placement

In the third year you will undertake a major industrial placement that lasts for between five and six months, beginning at the end of the Spring term and ending prior to the start of the Autumn term of your fourth year. As such, part of this placement will fall outside of regular term time.

There will be a small number of support lectures which will explain the placement and administration systems and give you an opportunity to ask questions. You will have a manager/mentor in the company to report to and will be treated as a full-time member of staff. An important part of the industrial placement assessment will be a reflection on legal, social and professional issues that you encountered. To ensure that the placement is running smoothly, your personal tutor will make a visit to the company and talk to both you and your manager/mentor.

Overall Workload

Your overall workload consists of face-to-face sessions and independent learning. In the first two years you will spend approximately 20% of your time in lectures and tutorials and approximately 5% in supervised laboratory sessions. The rest of the time is dedicated to independent study. The nominal total workload amounts to 60 ECTS per year and at Imperial, each [ECTS credit](#) taken equates to an expected total study time of 25 hours, i.e. approximately 1500 hours per year.

Assessment Strategy

Assessment Methods

You can expect a variety of different types of assessment methods:

- Programming exercises
- Online programming tests
- Written coursework
- Computer-based coursework
- Written examinations
- Computer-based examinations
- Software demonstrations
- Group working
- Written reports
- Research summaries
- Oral presentations

Each examinable module comprises coursework that is designed to help you master key elements of the subject and, in part, to help prepare you for the final assessment, which is typically a written or computer-based examination.

In each of the first two years there is a substantial programme of continuous assessment, which is mostly centred around practical laboratory exercises of growing size and complexity. In the first year there are also online programming tests for each of the major programming languages you will study.

You will receive written feedback on all coursework and laboratory exercises, including online programming tests. You will also receive verbal feedback on many other aspects of your study, such as presentation and problem solving skills and your progress in group and individual projects.

Written examinations are held at the beginning of the summer term for first and second year modules and at the end of the Autumn and Spring terms for third and fourth year modules. There are also progress tests at the end of the Autumn term of the first year designed primarily to assess how well you are coping with the mathematical foundations of the subject.

The weighting of coursework varies among modules, with the normal weighting being 15% of each taught module. The various assessments allow you to demonstrate that you have met the intended learning outcomes for each module and these collectively contribute towards your achievement of the programme learning outcomes, detailed above.

The industrial placement is designed to give you vital experience of working as part of a team in an industrial setting.

Collectively, the assessments are designed to ensure that you have acquired the core knowledge and skills expected of any Computing graduate and also that you are able to use these a. to solve the type of real-world problems encountered by industry, and b. to exploit effectively, and contribute to, cutting-edge research in Computing in an academic and/or industrial context.

Balance of assessment

The following are approximate percentages based on a typical pathway through the course. Note that laboratory work comprises mostly independent study, although supervised laboratory sessions are also timetabled throughout the year.

	Year 1	Year 2	Year 3	Year 4
Coursework	10	10	7.5	9
Examination	84	57	42.5	50
Practical	6	33	50	41

Academic Feedback Policy

Feedback will be provided in one of a number of formats, including:

- Written, e.g. in the form of specimen solutions, written and/or verbal comments on individual assignments, class-wide feedback.
- Verbal, e.g. during or after face-to-face discussions with an assessor or in a classroom feedback session.
- Peer-to-peer, e.g. from a senior undergraduate teaching assistant, or peer student
- Personal, e.g. from your personal tutor regarding your overall progress.

You will receive feedback on formative, developmental assessments and on summative coursework assessments. Feedback is normally returned within two weeks of submissions, although the turnaround time for final, i.e. summative, assessments may be longer; in those cases you will be informed in advanced of the planned return date.

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					
Year 1 – FHEQ Level 4					
Code	Module Title	Core/ Elective	Group*	Term	Credits
COMP40001	Introduction to Computer Systems	Core	N/A	1	5
COMP40002	Mathematics 1: Foundations	Core	N/A	1	5
COMP40003	Logic	Core	N/A	1	5
COMP40004	Discrete Mathematics	Core	N/A	1	5
COMP40005	Introduction to Computer Architecture	Core	N/A	2	5
COMP40006	Reasoning about Programs	Core	N/A	2	5
COMP40007	Introduction to Databases	Core	N/A	2	5
COMP40008	Graphs and Algorithms	Core	N/A	2	5
COMP40009	Computing Practical 1	Core	N/A	1, 2, 3	20
Credit Total					60
Year 2 – FHEQ Level 5					
In addition to the core modules you must select one module from the two electives.					
Code	Module Title	Core/ Elective	Group	Term	Credits
	Algorithm Design and Analysis	Core	N/A	1	5
	Software Engineering Design	Core	N/A	1	5
	Models of Computation	Core	N/A	1	5
	Operating Systems	Core	N/A	1	5
	Networks and Communications	Core	N/A	2	5
	Compilers	Core	N/A	2	5
	Mathematics 2: Probability and Statistics	Core	N/A	2	5
	Computing Practical 2	Core	N/A	1, 2	15
	2nd Year Computing Group Project	Core	N/A	3	5
	Introduction to Model-based Artificial Intelligence	Elective	N/A	2	5
	Mathematics 3: Computational Techniques	Elective	N/A	2	5
Credit Total					60

Year 3 - FHEQ Level 6

In addition to the core and compulsory modules you must select a total of three modules from the list of electives below, including between 1 and 3 modules from Group A and the rest from Group B. At most one of these can be from the Business School. The placement constitutes the equivalent of 15 ECTS of load in the third year, but this does not contribute to the final degree classification.

Code	Module Title	Core/ Elective	Group	Term	Credits
	Software Engineering Group Projects	Core		1	10
	Industrial Placement (First Part)	Core		3	15
	I-Explore	Compulsory		1 &/or 2	5
	Computer Vision	Compulsory		1	5
	Robotics	Compulsory		1	5
	Computer Graphics	Elective	A	2	5
	Computer Architecture	Elective	A	1	5
	Network and Web Security	Elective	A	2	5
	Pervasive Computing	Elective	A	2	5
	Introduction to Machine Learning	Elective	A	2	5
	Systems Verification	Elective	B	2	5
	Logic-Based Learning	Elective	B	2	5
	Concurrency	Elective	B	1	5
	Custom Computing	Elective	B	2	5
	Advanced Databases	Elective	B	1	5
	Communicating Computer Science in Schools	Elective	B	2	5
	Advanced Computer Architecture	Elective	B	2	5
	Simulation and Modelling	Elective	B	1	5
	Performance Engineering	Elective	B	2	5
	Operations Research	Elective	B	1	5
	Distributed Algorithms	Elective	B	2	5
	Information and Coding Theory	Elective	B	1	5
	Type Systems for Programming Languages	Elective	B	1	5
	Business School Modules (maximum one)	Elective	B	1 or 2	5
Credit Total					60

Year 4 - FHEQ Level 7

In addition to the core and compulsory modules you must select a total of five modules from the list of electives below, including between 3 and 5 modules from Group A and the rest from Group B. At most one of these can be from the Business School.

Code	Module Title	Core/ Elective	Group	Term	Credits
	Individual Project	Core		1, 2, 3	25
	Industrial Placement (Second Part)	Core		Summer	30
	Advanced Robotics	Compulsory		2	5
	Mathematics for Machine Learning	Compulsory		1	5
	Machine Learning for Imaging	Elective	A	2	5
	Advanced Computer Graphics	Elective	A	2	5
	Advanced Security in Smartphone and IoT Systems	Elective	A	1	5
	Deep Learning	Elective	A	2	5
	Separation Logic: Local Reasoning about Programs	Elective	B	1	5
	Scalable Systems for the Cloud	Elective	B	1	5
	Concurrent Processes	Elective	B	1	5
	Privacy Engineering	Elective	B	1	5
	Cryptography Engineering	Elective	B	2	5
	Computational Finance	Elective	B	2	5
	Complexity	Elective	B	1	5
	Software Reliability	Elective	B	2	5
	Principles of Distributed Ledgers	Elective	B	2	5
	Program Analysis	Elective	B	1	5
	Advanced Issues in Object Oriented Programming	Elective	B	1	5
	Machine Arguing	Elective	B	1	5
	Software Engineering for Industry	Elective	B	2	5
	Computational Optimisation	Elective	B	2	5
	Quantum Computing	Elective	B	1	5
	Natural Language Processing	Elective	B	2	5
	Probabilistic Inference	Elective	B	2	5
	Business School Modules (maximum one)	Elective	B	1 or 2	5

	High Performance Computing for Engineers (external module from EEE)	Elective	B	2	5
Credit Total					90

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.

In addition you must have achieved:

- i) At least 50.00% in Computing Practical 1 in order to progress to the second year.
- ii) An overall weighted average of at least 60.00% in the second year in order to progress to the third year. Students who fail to achieve this will normally be required to transfer to the third year of the BEng programme.

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.

Classification

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 is weighted at 20.00%, Year Three is weighted at 36.25% and Year Four is weighted at 36.25%.

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 |

Transferring from the MEng programme to the BEng programmes

Due to the shared core content in the first two years of all Computing degree programmes, it is possible to transfer from the MEng to the BEng programme at any point up until the beginning of the third year.

Transferring between MEng Computing specialisms

It is possible to transfer between the different MEng Computing degree specialisms at any point up until April in the fourth year of your programme, provided you have chosen elective modules in Years Three and Four which satisfy the compulsory module requirements for the target specialism.

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

As an accredited degree, students on the MEng programme are subject to the standards set by the Engineering Council in relation to compensation: a maximum of 15 ECTS credits can be compensated across the entire programme.

Supporting Information

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