MEng Computing - Artificial Intelligence and Machine Learning

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.

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<th>Programme Information</th>
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<tbody>
<tr>
<td>Programme Title</td>
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<td>Programme Code(s)</td>
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<td>Awarding Institution</td>
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<td>External Accreditor(s)</td>
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<td>Specification Details</td>
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Computing is a creative and wide-ranging subject that focuses on using sound underlying principles and logical thinking to design and build systems that really work. You will learn how modern computer and communications systems function, and how they can be used and adapted to build the next generation of computing applications. This course allows you to specialise in artificial intelligence and knowledge engineering, as well as the development of computational and engineering models of complex cognitive and social behaviours.

All of our Computing courses follow broadly the same structure for the first two years. Core modules give you an understanding of the basic concepts and principles of computing. We also provide a solid background in discrete mathematics (logic, sets, relations and grammars), which is the basic mathematics of computing, and classical mathematics and statistics relevant to applications engineering and management.

The central core of our courses has been designed to give you an overview of computing, an understanding of the basic concepts and principles, the ability to appreciate and to adapt to changes in technology, and practical experience in applied computing.

We place special emphasis on the fundamental principles underlying computing and on the engineering considerations involved in computing system design, implementation and usage. We will also introduce you to computing architecture and hardware, alongside the software that can exploit them.

You will attend laboratory and problem-solving classes, as well as completing project and design work throughout the course.

As the course progresses, you will study advanced techniques and modules, many of which draw on current research taking place in the Department.

At the end of your third year you will gain valuable skills and experience by completing an industrial placement.

Your study reaches Master’s level in the final year, with a wide choice of optional modules and a substantial individual project on a subject of your choice.

Learning Outcomes

Knowledge and Understanding of:

- The major paradigms of high-level programming: declarative, imperative and object-oriented;
- Fundamental Computing concepts, including computer hardware, computer architecture, operating systems, programming, program design, fundamental algorithms, compilers, databases, networks and communications, human computer interaction, and many application areas such as e-commerce, graphics and artificial intelligence;
- The underlying mathematical foundations of Computing, including logic, discrete mathematics, computability, and complexity;
• Formal aspects of software engineering, including program specification, program reasoning and design methods;
• Continuous mathematics relevant to a wide range of application areas including computer graphics, operations research, optimisation, performance analysis and scientific computing;
• Practical aspects of software engineering and engineering design;
• Communication skills, including project specification, system design, teamwork, written and oral presentation and literature search;
• Moral and ethical issues, including professional conduct, law and plagiarism;
• In depth understanding of a broad range of research work in Department’s areas of expertise;
• Ability to conduct research into the current state of the art in computing;

**Intellectual Skills:**
• Analyse computing system design problems of varying types and specify those problems, and proposed solutions, in a suitable formalism;
• Reason about program correctness and algorithm complexity;
• Construct abstract models of computer and communication systems for the purposes of functional and performance analysis;
• Analyse unseen problems and select tools and techniques most suitable for solving them;
• Design experiments for the purposes of testing and evaluation;
• Perform critical evaluation of alternative designs and solution techniques for a wide range of problems;
• Develop an understanding of the theory, practice and trends of more advanced computing topics;
• Understand current research work and undertake independent research;

**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;
• Analyse computing problems and devise appropriate solutions to them;
• Give technical presentations;
• Prepare technical reports;
• Conduct detailed literature searches;
• Plan, conduct and write up a programme of development conducted in a team;
• Plan, conduct and write-up a programme of research and development conducted as an individual;
• Design high quality user interfaces;
• Apply mathematical knowledge to Computing problems of a numerical nature;

**Transferable Skills:**
• Communicate effectively through oral presentations, computer presentations and written reports;
• Program in the major computer programming paradigms;
• Use the World Wide Web effectively;
• Integrate and evaluate information from multiple and diverse sources;
• Work within and contribute to a team, apply management skills such as co-ordination, project design and evaluation and decision processes as applied in software engineering;
• Manage resources and time;
• Learn independently with open-mindedness and critical enquiry;
• Learn effectively for the purpose of continuing professional development;
• Apply research skills to develop an in depth understanding of a new or emerging topic, and then extend the state of the art in that topic;

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](http://www.imperial.ac.uk/students/academic-support/graduate-attributes)

### Entry Requirements

<table>
<thead>
<tr>
<th>Academic Requirement</th>
<th>Grade Requirement</th>
<th>Subject Requirements</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Normally a minimum of A*AA overall</td>
<td>A* in Mathematics A in two further accepted A-levels (Further Mathematics is highly recommended. Other useful A-levels include: Ancient Language, Biology, Chemistry, Computing, Economics, Electronics, English Literature, History, Law, Modern Language, Philosophy, Physics, Politics and Psychology) (or a comparable qualification recognised by the College).</td>
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</tbody>
</table>

| Excluded Subjects          | ICT, Business Studies and General Studies |

<table>
<thead>
<tr>
<th>International Baccalaureate (IB)</th>
<th>Grade Requirement</th>
<th>Minimum 39 points</th>
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<tbody>
<tr>
<td>Subject Requirements</td>
<td>7 in Mathematics at higher level 6 in one further relevant subject at higher level (for example Physics, Computer Science, Chemistry, Economics, Biology)</td>
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</table>

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<thead>
<tr>
<th>English Language Requirement</th>
<th>Standard requirement</th>
<th>IELTS score of 6.5 overall (minimum 6.0 in all elements)</th>
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<thead>
<tr>
<th>Admissions Tests</th>
<th>Candidates may be asked to undertake an admissions test set by the College in order to provide additional information for the Admissions Tutor in support of an application.</th>
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<tr>
<th>Interview</th>
<th>Selected candidates only</th>
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The programme’s competency standards document can be found at: [http://www.imperial.ac.uk/computing/prospective-students/courses/competence/](http://www.imperial.ac.uk/computing/prospective-students/courses/competence/)

### Learning & Teaching Strategy

<table>
<thead>
<tr>
<th>Scheduled Learning &amp; Teaching Methods</th>
<th>Lectures</th>
<th>Tutorials</th>
<th>Practical work</th>
<th>Laboratory work</th>
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</table>

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<tr>
<th>Project Learning Methods</th>
<th>• Independent research project</th>
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</thead>
<tbody>
<tr>
<td>Placement Learning Methods</td>
<td>• Industrial placement</td>
</tr>
<tr>
<td><strong>Assessment Strategy</strong></td>
<td></td>
</tr>
</tbody>
</table>

| Assessment Methods | • Individual projects  
|                    | • Group projects  
|                    | • Reports  
|                    | • Presentations  
|                    | • Written examinations  
|                    | • Laboratory-based examinations  
|                    | • Coursework  
|                    | • Laboratory work  
|                    | • Programming tests |

| **Academic Feedback Policy** |

Feedback will be provided on coursework within two weeks of submission. This will be in the form of, for example:

- 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;

In lieu of feedback on examinations, selected examination questions are routinely set as unassessed problems in the following year, with model answers provided.

| **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/](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/](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

Rules of Progression

Year One
In order to pass the first year and qualify to progress to the second year, the candidate must achieve:
- A minimum of 40% in each module;
- A minimum of 40% overall.

Year Two
In order to pass the second year and qualify to progress to the third year, the candidate must achieve:
- A minimum of 40% in each module;
- A minimum of 40% overall.

Year Three
To qualify for the fourth year students must normally obtain an overall mark of at least 40% in the third year, including at least 40% in the group project. Students who fail to achieve this will normally be required to transfer to the BEng degree and complete an individual project.

Marking Scheme

Final Degree Classifications
The marks for all components of the four years of the course are aggregated into an overall mark. The class of Honours awarded depends on this overall mark, with the proviso that candidates must have achieved at least 40% overall in the fourth year and normally at least 40% in their individual project.

The Pass Mark for all undergraduate modules is 40%. The MEng degree mark is calculated with the year weightings 1:2:2:4.

In addition to these requirements, candidates are normally expected to successfully complete the MEng degree programme in four continuous years.

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%
<table>
<thead>
<tr>
<th>Year</th>
<th>Module Weightings</th>
</tr>
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</table>
| 1 (11.1%) | **Reasoning About Programs** 7.05%  
**Databases 1** 8.82%  
**Architecture** 8.82%  
**Mathematical Methods** 8.82%  
**Logic** 8.82%  
**Programming 1 (Haskell)** 10.11%  
**Programming 2 (Java)** 13.00%  
**Discrete Structures** 7.05%  
**Graphs and Algorithms** 7.05%  
**Laboratory 1** 0.00%  
**Computing Topics** 4.70%  
**Ethics in Computing 1** 0.58%  
**Presentation Skills** 0.58%  
**Hardware** 8.82%  
**Programming 3 (C)** 5.77%  
**Year 1 Extracurricular** 0.00% |
| 2 (22.2%) | **Compilers** 8.23%  
**Software Engineering - Design** 8.23%  
**Networks and Communications** 8.23%  
**Operating Systems** 8.23%  
**Models of Computation** 8.23%  
**2nd Year Computing Group Project** 10.58%  
**Probability and Statistics** 8.23%  
**Laboratory 2** 23.52%  
**Advanced Laboratory 2** 0.00%  
**An Introduction to Law for Computer Scientists** 0.00%  
**Introduction to Prolog** 0.00%  
**Introduction to Artificial Intelligence** 8.23%  
**Algorithms 2** 8.23%  
**Year 2 Extracurricular** 0.00% |
| 3 (22.2%) | **3rd Year Software Engineering Group Project** 25.88%  
**Machine Learning** 10.58%  
**Electives (AT LEAST 5 from group A and NO MORE THAN 1 from group B)** 10.58% each  
**Year 3 Extracurricular** 0.00% |
| 4 (44.4%) | **Computing Industrial Placement** 0.00%  
**Individual Project MEng** 45.47%  
**Electives (AT LEAST 9 ECTS from group C and 4.5 ECTS from groups D and E, NO MORE THAN 12 ECTS from group E)** 7.79% each  
**Year 4 Extracurricular** 0.00% |
<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Core/Elective</th>
<th>Year</th>
<th>L&amp;T Hours</th>
<th>Ind. Study Hours</th>
<th>Place-ment Hours</th>
<th>Total Hours</th>
<th>FHEQ Level</th>
<th>ECTS</th>
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<td>Architecture</td>
<td>Core</td>
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<td>27</td>
<td>73</td>
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<td>100</td>
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<td>Programming 1 (Haskell)</td>
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<tr>
<td>Code</td>
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<td>Networks and Communications</td>
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<td>2</td>
<td>See module leader</td>
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<td>CO220</td>
<td>Software Engineering - Design</td>
<td>Core</td>
<td>2</td>
<td>See module leader</td>
<td>100</td>
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<td>4</td>
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<td>CO221</td>
<td>Compilers</td>
<td>Core</td>
<td>2</td>
<td>See module leader</td>
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<td>CO240</td>
<td>Models of Computation</td>
<td>Core</td>
<td>2</td>
<td>See module leader</td>
<td>100</td>
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<tr>
<td>CO245</td>
<td>Probability and Statistics</td>
<td>Core</td>
<td>2</td>
<td>See module leader</td>
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<td>5</td>
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<td>Laboratory 2</td>
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<td>CO261C</td>
<td>Advanced Laboratory 2</td>
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<td>CO273</td>
<td>An Introduction to Law for Computer Scientists</td>
<td>Core</td>
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<td>CO276</td>
<td>Introduction to Prolog</td>
<td>Core</td>
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<tr>
<td>Code</td>
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<td>CO202</td>
<td>Algorithms 2</td>
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<td>Introduction to Model-based Artificial Intelligence</td>
<td>Elective (A)</td>
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<td>CO233</td>
<td>Computational Techniques</td>
<td>Elective (A)</td>
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<td>CO701</td>
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