Imperial College London

Programme Specification (Master's Level)

MSc Applied Computational Science and Engineering

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 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.

Programme Information				
Award(s)	MSc			
Programme Title	Applied Computational Science and Engineering (ACSE)			
Programme code	F6UC			
Awarding Institution	Imperial College London			
Teaching Institution	Imperial College London			
Faculty	Faculty of Engineering			
Department	Department of Earth Science and Engineering			
Associateship	n/a			
Mode and Period of Study	MSc: 1 calendar year full-time (12 months)			
Cohort Entry Points	Annually in October			
Relevant QAA Benchmark Statement(s) and/or other external reference points	Master's Awards in Engineering			
Total Credits	ECTS:	90	UK Credits:	180
FHEQ Level	Level 7 - Master's			
EHEA Level	2nd cycle			
External Accreditor(s)	None			
Specification Details				
Student cohorts covered by specification	2022-23 entry			
Person Responsible for the specification	Dr Gerard Gorman			
Date of introduction of programme	September 2018			

Date of programme specification/revision	September 2022

Description of Programme Contents

The MSc Applied Computational Science and Engineering will educate future domain-specialists in computational science. The programme takes students through a programme of learning that will enable a deepening of knowledge and skills associated with cutting edge computational techniques for science and engineering applications.

The programme is aimed at three different groups of potential students :

- those with strong methodological backgrounds in mathematics or physical sciences who are wishing to move to an applied field with vast potential for developing novel approaches to applications in science and engineering;
- those with a more applied background in geophysics or engineering, wishing to learn about computational science and how it can be used as a problem solving tool;
- those with a background in computer science wishing to expand their knowledge of numerical methods and the ways in which these can be utilised to solve large scale engineering science problems.

The overall objective of the MSc programme is to ensure that students are able to use appropriate computational methods to understand, define and develop solutions to a range of science and engineering problems. Students successfully completing the programme will have acquired a strong background in computational techniques, numerical methods, development of computer code using a range of languages, parallel algorithms, and have applied these skills and techniques to a range of science and engineering applications utilising High Performance Computing resources.

The knowledge and experience gathered through completion of the programme will place students in an ideal position to potentially:

- pursue academic careers (through a PhD for instance) in many fields: computational techniques, numerical analysis, optimisation and inversion, fluid mechanics, heat transfer, machine learning applications.
- work as an expert analyst in industry, for example oil and gas, mineral exploration, climate science

The programme consists of eight taught modules which are equally weighted, delivered over the first two terms of the academic year, followed by a research project. The eight taught modules will cover a range of computational methods including how these can be practically applied. Each module will explore examples and applications to engineering and science problems in order to explore the subject matter.

The programme will be taught by an expert staff members who will draw on their research and industrial application experience at national and international level to ensure students are provided with an opportunity to engage with a broad range of modern techniques and applications. Students will also have the opportunity to undertake research with academics within the top-rated Earth Science and Engineering Department from REF2014 and RAE2008.

The programme will be delivered on the South Kensington Campus, within the Earth Science and Engineering department's facilities in the Royal School of Mines Building. A fundamental component of the programme is the use of computing resources, for this the students will have access to the

College's High Performance Computing resources. This will allow students to cement principles introduced on the taught part of the programme, as well as inspiring the future crop of experts in Computational Science.

Learning Outcomes

Upon successful completion of the programme, students should be able to:

1. undertake reproducible computational science
2. use a variety of programming languages to create, test, verify and validate contextually appropriate software
3. compare and contrast methods in mathematical modelling, numerical methods, machine learning and control optimisation which are commonly used in science and engineering applications
4. relate the underpinning mathematics of continuum mechanics to important physical processes in science and engineering
5. use systematic knowledge of high performance computing and parallel computing to employ appropriate computational techniques when using these resources
6. apply knowledge of computational techniques to a range of science and engineering applications
7. generate original thinking on how to use and combine existing computational techniques to address questions arising from science and engineering applications
8. identify relevant and original research questions from existing data sets and models, and select appropriate techniques to address them
9. undertake original independent research in an area of computational science, under the guidance of academic staff
10. critically evaluate the work of others and propose alternative techniques, approaches or solutions
11. plan their individual work and their contributions to collaborative work
12. write technical reports and summarise their work using presentations

To achieve the PGDip Exit Award students will be required to accumulate 60 ECTS at FHEQ Level 7. This is equivalent to the students passing all but the project part of the given MSc.

Intended learning objectives for the PGDip Applied Computational Science and Engineering

1. undertake reproducible computational science
2. use a variety of programming languages to create, test, verify and validate contextually appropriate software
3. compare and contrast methods in mathematical modelling, numerical methods, machine learning and control optimisation which are commonly used in science and engineering applications
4. relate the underpinning mathematics of continuum mechanics to important physical processes in science and engineering
5. use systematic knowledge of high performance computing and parallel computing to employ appropriate computational techniques when using these resources
6. apply knowledge of computational techniques to a range of science and engineering applications
7. plan their individual work and their contributions to collaborative work

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	Normally a 2:1 UK Bachelor's Degree or equivalent, in an engineering or science-based discipline.
Additional Requirements	None
Applicants who do not meet the academic requirements above but who have substantial relevant industry experience may be admitted following completion of a 'Special Qualifying Exam' (SQE)	
Applicants will be invited to attend a post-application interview	
English Language Requirement	Standard Requirements: IELTS 6.5 with a minimum of 6.0 in each element or equivalent
Learning & Teaching Strategy	
Scheduled Learning & Teaching Methods	• Lectures • Seminars and practical coding activities • Case studies • Group work exercises • Formal presentations
E-learning & Blended Learning Methods	All the module content will be available online. The lectures themselves will have a strong emphasis on skills development, where short lectures will punctuated by individual or paired exercises with the support of teaching staff.
Project Learning Methods	Individual and group projects will run throughout the year. These are primarily software based projects that make heavy use of automated assessment to enable self-assessment. These smaller projects also help prepare the student for the independent project at the end of the year.
Placement Learning Methods	Students will undertake their research project within a research group. There will be no external placements.
Assessment Strategy	
Assessment Methods	• Individual and group coursework • Research project report • Oral presentations
Academic Feedback Policy	
Feedback on coursework will be provided in line with the College's Policy on Academic Feedback. The good practice guidelines of feedback being provided within two weeks of the submission date will be employed. Provisional examination marks will be provided within six weeks of the end of the exam	

block. The final numerical marks will be provided by the Registry after the Board of Examiner's meeting at the end of the academic year.

Re-sit Policy
Students who fail assessments will be provided with the opportunity for one re-sit. Students may choose whether to re-sit failed examinations in the September re-sit period or with the next cohort in the following academic year. Students who need to re-sit examinations/resubmit their final report may be required to pay a re-sit fee.

Mitigating Circumstances Policy
The College's Policy on Mitigating Circumstances is available at: www.imperial.ac.uk/registry/exams

Programme Structure

Full-time	Pre-session	Term One	Term Two	Term Three	Term Four
Core Modules	0	3.33	3.33	1.34	0
Elective Modules	0	0	0	0	0
Projects	0	0	0	1	

Assessment Dates & Deadlines

Written Examinations	None
Coursework Assessments	Continuous
Project Deadlines	Mid September
Practical Assessments	Continuous

Assessment Structure

Programme Component	ECTS	% Weighting
Modern Programming Methods (EART97037)	7.5	8.33%
Computational Mathematics (EART97038)	5	5.55%
Modelling and Numerical Methods (EART97039)	10	11.11%
Applying Computational/Data Science (EART97040)	7.5	8.33%
Advanced Programming (EART97041)	7.5	8.33%
Patterns for parallel programming (EART97042)	7.5	8.33%

Inversion and optimisation (EART97043)	7.5	8.33%
Machine learning (EART97044)	7.5	8.33%
Applied Computational/Data Science Project (EART97045)	30	33.33%
Total	90	100%

Marking Scheme

Clear criteria for marking written work, oral presentations and the research project will be used for assessments across all modules to ensure consistency in marking and requirements for Pass, Merit and Distinction grades.

The MSc can be awarded as a Pass, Merit or Distinction.

In order to be awarded a **Pass**, a student must:

- Achieve an aggregate mark of at least 50% across the eight taught modules
- Achieve a mark of at least 50% in the Research Project

In order to be awarded a **Merit**, a student must:

- Achieve an aggregate mark of at least 60% across the eight taught modules
- Achieve a mark of at least 60% in the Research Project

In order to be awarded a **Distinction**, a student must:

- Achieve an aggregate mark of at least 70% across the eight taught modules
- Achieve a mark of at least 70% in the Research Project

The anticipated College regulations regarding credit compensation will be applied to this programme.

Candidates will normally only be considered for promotion to pass, merit or distinction if their overall aggregate mark is within 2.5% of the relevant borderline. Candidates whom the Board of Examiners deem to have mitigating circumstances may be considered for promotion if their overall aggregate mark is within 5% of the relevant borderline. A viva will normally be called to examine students who are being considered for promotion to a higher degree classification.

To qualify for the award of a postgraduate diploma a student must have a minimum of 60 ECTS at Level 7 credits obtained only from the taught modules taken, i.e. excluding the Project.

The Board of Examiners will comprise of the Programme Director, Module Leaders and External Examiners, in line with College policy.

Indicative Module List												
Code	Title	Core/ Elective	Year	L&T Hours	Ind. Study Hours	Place-ment Hours	Total Hours	% Written Exam	% Course-work	% Practical	FHEQ Level	ECTS
Assessed modules												
EART97037	Modern Programming Methods	Core	1	36	151.5	0	187.5	0%	100%	0%	7	7.5
EART97038	Computational Mathematics	Core	1	24	101	0	125	0%	100%	0%	7	5
EART97039	Modelling and Numerical methods	Core	1	48	202	0	250	0%	100%	0%	7	10
EART97040	Applying Computational/Data Science	Core	1	27	160.5	0	187.5	0%	100%	0%	7	7.5
EART97041	Advanced Programming Methods	Core	1	36	151.5	0	187.5	0%	100%	0%	7	7.5
EART97042	Patterns for parallel programming	Core	1	36	151.5	0	187.5	0%	100%	0%	7	7.5
EART97043	Inversion and optimisation	Core	1	36	151.5	0	187.5	0%	100%	0%	7	7.5
EART97044	Machine learning	Core	1	36	151.5	0	187.5	0%	100%	0%	7	7.5
EART97045	Applied Computational/Data Science Project	Core	1	10	740	0	750	0%	80%	20%	7	30

Supporting Information
The Programme Handbook is available at: TBC
The Module Handbook is available at: TBC
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: http://www3.imperial.ac.uk/registry/proceduresandregulations/regulations
Imperial College is an independent corporation whose legal status derives from a Royal Charter granted under Letters Patent in 1907. In 2007 a Supplemental Charter and Statutes was granted by HM Queen Elizabeth II. This Supplemental Charter, which came into force on the date of the College's Centenary, 8th July 2007, established the College as a University with the name and style of "The Imperial College of Science, Technology and Medicine". http://www.imperial.ac.uk/admin-services/secretariat/college-governance/charters-statutes-ordinances-and-regulations/
Imperial College London is regulated by the Higher Education Funding Council for England (HEFCE) http://www.hefce.ac.uk/reg/of/