

MSc in Control and Optimisation

This document provides a definitive record of the main features of the programme and the learning outcomes that a typical student may reasonably be expected to achieve and demonstrate if s/he takes full advantage of the learning opportunities provided. This programme specification is intended as a reference point for prospective students, current students, external examiners and academic and support staff involved in delivering the programme and enabling student development and achievement.

Programme Information

Programme Title	Control and Optimisation	
Award(s)	MSc	
Programme Code	J9U4	
Awarding Institution	Imperial College London	
Teaching Institution	Imperial College London	
Faculty	Faculty of Engineering	
Department	Department of Electrical and Electronic Engineering	
Associateship	City and Guilds of London Institute (ACGI)	
Main Location of Study	South Kensington Campus	
Mode and Period of Study	1 academic year full-time	
Cohort Entry Points	Annually in October	
Relevant QAA Benchmark Statement(s) and/or other external reference points	Master's Degree in Engineering	
Total Credits	ECTS: 90	CATS: 180
FHEQ Level	Level 7	
EHEA Level	2 nd cycle	
External Accrerator(s)	IET Accreditation received: 2013 Accreditation renewal: 2023	
Specification Details		
Student cohorts covered by specification	2021-2022 entry	
Person responsible for the specification	Prof David Angeli, MSc Course Director	

Date of introduction of programme	October 1978
Date of programme specification/revision	October 2021
Programme Overview	
<p>This course will introduce students to the major aspects of control theory and optimisation, as well as their application to the design of automated systems. Students will develop skills in the use of the standard computer packages for control design and optimisation.</p> <p>In response to the growing demands of the chemical, oil, aerospace, aeronautical, power, transport and defence industries, control theory and optimisation have developed into a well-established body of knowledge that many engineers need to acquire. Additional areas of application include:</p> <ul style="list-style-type: none"> • industrial automation • robotics • mechanical systems • biomedical control 	
Learning Outcomes	
<p>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</p>	
Knowledge and Understanding of:	
<ol style="list-style-type: none"> 1. Fundamental concepts and principles underpinning control system theory and design, including those associated with linear and non-linear deterministic systems, stochastic systems, modelling, convex and non-convex optimisation, optimisation-based control, on-line control. 2. The essential facts, concepts, principles and theories relevant to the student's chosen area of research for the individual project. 3. Information retrieval as a research technique. 4. Management and communication skills, including problem definition, project design, decision processes, written reports, scientific publications. 	
Intellectual (thinking) skills - able to:	
<ol style="list-style-type: none"> 1. (Analysis) model systems mathematically and apply relevant theory to study their properties and performance. 2. (Optimisation) devise abstract mathematical models pertaining to practical engineering problems and identify variables, constraints, and cost functions appropriate for designing efficient solutions. 3. (Synthesis) interpret and apply control concepts and theory to the solution of control design problems. 4. (Computing) apply computational principles and techniques to control and optimisation problems. 5. (Evaluative) plan, conduct and report on a programme of original research. 	

Practical skills – able to:

1. Formulate mathematical models of systems and identify the parameters of such models from observations using appropriate statistical techniques.
2. Solve control analysis and synthesis problems using appropriate statistical, frequency-response and state-space methods.
3. Formulate and classify optimisation problems as linear/quadratic/convex/nonconvex and apply suitable computational tools for their solution.
4. Analyse and interpret computed results.
5. Write programs using at least one common language (Matlab).
6. Understand the literature so personal knowledge and skills can be kept up-to-date.
7. Define problems and design /manage associated projects.
8. Write effective technical reports.

Transferable skills – able to:

1. Communicate effectively, as a result of clear and precise thinking, using presentations, web-pages and written reports.
2. Apply knowledge skills to new control and optimisation problems.
3. (Management skills) formulate problem definitions; design and evaluate projects using objective criteria.
4. Transfer techniques and solutions from one discipline to another.
5. Use Information and Communications Technology.
6. Manage resources and time.
7. Learn independently with open-mindedness and critical enquiry.
8. Learn effectively for the purpose of continuing professional development.

Entry Requirements

Academic Requirement	Normally a high first class (1st) (75%+) UK Bachelor's Degree with Honours in Electrical Engineering or a related subject (or a comparable qualification recognised by the College).
Non-academic Requirements	N/A
Interviews for applicants are not required.	
English Language Requirement	Higher English requirement IELTS 7 with a minimum of 6.5 in each element or equivalent
The programme's competency standards document can be found at: http://www.imperial.ac.uk/electrical-engineering/study/undergraduate/applicants-with-disabilities/	
Learning & Teaching Strategy	
Scheduled Learning & Teaching Methods	<ul style="list-style-type: none"> • Lectures • Problem solving classes • Tutorial sessions

E-learning & Blended Learning Methods	<ul style="list-style-type: none"> • Hardware laboratory • Software laboratory 		
Project Learning Methods	<ul style="list-style-type: none"> • Group projects • Individual projects • Industrial placement 		
Assessment Strategy			
Assessment Methods	<ul style="list-style-type: none"> • Written examinations • Coursework software or hardware deliverable • Oral and poster presentations • Reports 		
Academic Feedback Policy			
Feedback to all submitted coursework is expected within two weeks			
<p>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:</p> <ul style="list-style-type: none"> • All coursework is promptly marked • Meeting of individual students with course directors to discuss exams, research project and career aims • General remarks are communicated by broadcast emails to all Course students • More details given to representatives in the Staff – Student Committee <p>Course questionnaire evaluation of taught components</p>			
Re-sit Policy			
The College's Policy on Re-sits is available at: http://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: http://www.imperial.ac.uk/student-records-and-data/for-current-students/undergraduate-and-taught-postgraduate/exams-assessments-and-regulations/			
Programme Structure			
Full-time	Term One	Term Two	Term Three
Core Modules (elective A)	4	3	0
Elective (B and C) Modules	5	9	0
Projects	0	0	1
Assessment Dates & Deadlines			

Written Examinations	December and May
Coursework Assessments	Continuous
Project Deadlines	Initial Project Report: Mid-March Poster Submission: Late August Project Submission: Early September Poster Presentation: Early September
Practical Assessments	Laboratory Report: Mid-June
Assessment Structure	
Marking Scheme	
Final Degree Classifications	
An MSc degree will be awarded to students obtaining:	
<ul style="list-style-type: none"> at least 40% for each of the 8 modules counted for the computation of the examinations average at least 50% for the laboratory work average at least 50% for both the project and examinations average 	
MSc degree with merit will be awarded to students obtaining	
<ul style="list-style-type: none"> at least 40% for each of the 8 modules counted for the computation of the examinations average at least 50% for the laboratory work average at least 60% for both the project and examinations average 	
MSc degree with distinction will be awarded to students obtaining	
<ul style="list-style-type: none"> at least 40% for each of the 8 modules counted for the computation of the examinations average at least 50% for the laboratory work average at least 70% for both the project and examinations average 	
Module Weightings	
Module	% Module Weighting
Minimum of 4 modules from elective group (A)*	N/A
Modules from elective group (B)*	N/A
Modules from elective group (C)*	N/A
C1 Lab	N/A

Individual Research Project	N/A
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***Please note that there are seven elective group (A) modules. Students MUST choose at least 4 CORE modules from elective (A). The remaining elective modules can be chosen from elective (B) and elective (C). However, only ONE of the chosen elective modules can be picked from elective (C).**

Please note that students who opt to take nine modules, the best selection of eight modules will be considered among all those including at least 4 elective group (A) modules, when calculating the final degree classification.

Indicative Module List											
Code	Title	Core/ Elective	L&T Hours	Ind. Study Hours	Place- ment Hours	Total Hours	% Written Exam	% Course- work	% Practical	FHEQ Level	ECTS
ELEC97017	Control Engineering	ELECTIVE (A)	20	105	0	125	100%	0%	0%	7	5
ELEC97098	Design of Linear Multivariable Control Systems	ELECTIVE (A)	20	105	0	125	75%	25%	0%	7	5
ELEC97028	Digital Control Systems	ELECTIVE (A)	20	105	0	125	75%	25%	0%	7	5
ELEC97082	Stability and Control of Non-linear Systems	ELECTIVE (A)	20	105	0	125	75%	25%	0%	7	5
ELEC97063	Optimisation	ELECTIVE (A)	20	105	0	125	75%	25%	0%	7	5
ELEC97071	Predictive Control	ELECTIVE (A)	20	105	0	125	0%	100%	0%	7	5
ELEC97086	Systems Identification and Learning	ELECTIVE (A)	20	105	0	125	75%	25%	0%	7	5
ELEC97026	Discrete-Event Systems	ELECTIVE (B)	20	105	0	125	75%	25%	0%	7	5
ELEC97054	Mathematics for Signals and Systems	ELECTIVE (B)	20	105	0	125	100%	0%	0%	7	5
ELEC97073	Probability and Stochastic Processes	ELECTIVE (B)	20	105	0	125	85%	15%	0%	7	5
ELEC97059	Modelling and Control of Multi-body Mechanical Systems	ELECTIVE (B)	20	105	0	125	75%	25%	0%	7	5
ELEC97067	Power System Dynamics, Stability and Control	ELECTIVE (B)	20	105	0	125	100%	0%	0%	7	5
ELEC97087	Topics in Control Systems	ELECTIVE (B)	14	111	0	125	0%	100%	0%	7	5

Indicative Module List											
Code	Title	Core/ Elective	L&T Hours	Ind. Study Hours	Place- ment Hours	Total Hours	% Written Exam	% Course- work	% Practical	FHEQ Level	ECTS
ELEC97120	Optimal Control	ELECTIVE (B)	20	105	0	125	75%	25%	0%	7	5
ELEC97119	Advanced Optimisation	ELECTIVE (B)	20	105	0	125	60%	40%	0%	7	5
ELEC97093	Wavelets, Representation Learning and their Applications	ELECTIVE (C)	20	105	0	125	75%	25%	0%	7	5
ELEC97091	Traffic Theory & Queuing Systems	ELECTIVE (C)	20	105	0	125	100%	0%	0%	7	5
ELEC97014	Coding Theory	ELECTIVE (C)	20	105	0	125	0%	100%	0%	7	5
ELEC97049	Information Theory	ELECTIVE (C)	20	105	0	125	100%	0%	0%	7	5
ELEC97076	Real-time Digital Signal Processing	ELECTIVE (C)	20	105	0	125	0%	100%	0%	7	5
ELEC97113	Computer Vision and Pattern Recognition	ELECTIVE (C)	20	105	0	125	0%	100%	0%	7	5
ELEC97012	C1 LAB	CORE	2	248	0	250	0%	100%	0%	7	10
ELEC97018	Individual Research Project	CORE	0	1000	0	1000	0%	100%	0%	7	40

Supporting Information

The Programme Handbook is available at:

<http://www.imperial.ac.uk/electrical-engineering/study/current-students-course-handbook/#m>

The Module Handbook is available at:

http://intranet.ee.ic.ac.uk/electricalengineering/eecourses_t4/crslistpg.asp?c=C1

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:

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

Imperial College is an independent corporation whose legal status derives from a Royal Charter granted under Letters Patent in 1907. In 2007 a Supplemental Charter and Statutes was granted by HM Queen Elizabeth II. This Supplemental Charter, which came into force on the date of the College's Centenary, 8th July 2007, established the College as a University with the name and style of "The Imperial College of Science, Technology and Medicine".

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

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<https://www.officeforstudents.org.uk/>