

Programme Information		
Programme Title	Programme Code	HECoS Code
Control and Optimisation	J9U4	For Registry Use Only

Award	Length of Study	Mode of Study	Entry Point(s)	Total Credits	
				ECTS	CATS
MSc	1 Calendar Year (12 months)	Full-Time	Annually in October	90	180
PG Diploma	N/A	Full-Time	N/A	60	120
PG Certificate	N/A	Full-Time	N/A	30	60

The PG Certificate and PG Diploma are intermediate awards and are not available for entry. All students must apply to and join the MSc. These exit awards are not currently accredited by the IET

Ownership			
Awarding Institution	Imperial College London	Faculty	Faculty of Engineering
Teaching Institution	Imperial College London	Department	Electrical and Electronic Engineering
Associateship	City and Guilds of London Institute	Main Location(s) of Study	South Kensington Campus
External Reference			
Relevant QAA Benchmark Statement(s) and/or other external reference points	Master's degree in Engineering		
FHEQ Level	Level 7		
EHEA Level	2nd Cycle		
External Accrator(s) (if applicable)			
External Accrator 1:	The Institution of Engineering and Technology (IET)		
Accreditation received:	2018	Accreditation renewal:	2023
Collaborative Provision			
Collaborative partner	Collaboration type	Agreement effective date	Agreement expiry date
N/A	N/A	N/A	N/A
Specification Details			
Programme Lead	Prof David Angeli		

Student cohorts covered by specification	2022-23 entry
Date of introduction of programme	October 22
Date of programme specification/revision	September 22

Programme Overview

In response to the growing demands of the chemical, oil, aerospace, aeronautical, power, transport and defence industries, control theory and optimisation has developed into a well-established body of knowledge that many engineers need to acquire. Additional areas of application include industrial automation, robotics, mechanical and biomedical engineering.

This programme will introduce you to the major aspects of control theory and optimisation, as well as their application to the design of automated systems. The focus of the programme is on foundational aspects to allow the widest possible range of industrial destination sectors (as listed above) and is especially suited if you have a keen interest in research both in Industry and Academia (PhD level and above). In addition, you will be able to select your elective modules and research project to further focus your MSc qualification towards a specific career path. Your programme will be delivered within the Department of Electrical and Electronic Engineering. The programme is structured in three parts: the elective modules delivered in autumn and spring term, that you can choose after conversation with your personal tutor, provide the foundation for you to build on during your individual project.

Throughout the programme there are many opportunities for you to work on your own as well as part of a team in group work; experiences which test your communication, leadership, and interpersonal skills as well as your technical competence, time, and project management skills are developed throughout the programme.

The degree is assessed by written examination, coursework – either individually or as a group, and an individual research project, run as a part-time activity from January to May and then full time from May to September. It may be possible for MSc projects to be carried out with industry. The taught modules are confined to the autumn and spring terms, with all examinations held during the summer term.

The final project allows you to engage in research activity and can be carried out both within the Department, under the supervision of a staff member, or in collaboration with industrial partners or other selected Imperial College London Laboratories.

The Control and Optimisation MSc programme is delivered by research-leading academics with backgrounds in Control Engineering, Optimisation and other Engineering sectors and draws upon their extensive and diverse portfolio of research activities.

Learning Outcomes

On completion of the MSc in Control and Optimisation, you will be able to:

1. Critique and analyse system's models and apply relevant theory to characterize their properties and performance.
2. Design abstract models pertaining to engineering problems and identify variables, constraints, and objectives appropriate for designing efficient solutions.
3. Evaluate and apply Control Theory methods for the solution of control design problems.
4. Appraise and apply computational principles and implement algorithms to solve optimisation and control problems.
5. Plan, conduct and report on a programme of original independent research that demonstrates a contribution to knowledge in a state of the art research area.
6. Appraise, compare and critically review scientific and technical literature pertaining to control and optimisation.
7. Communicate effectively, as a result of clear and precise thinking, using presentations, emails and written reports.
8. Learn independently with open-mindedness and critical enquiry.
9. Manage resources and time towards successful completion of a task, both individually and in a team.
10. Assess the challenges and opportunities of developments in the field of Control and Optimisation.

On completion of the PG Certificate you will be able to achieve the ILOs 1 to 4 listed above.

On completion of the PG Diploma you will be able to achieve the ILOs 1 to 7 listed above.

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 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
English Language Requirement	Higher requirement (PG) Please check for other Accepted English Qualifications
Admissions Test/Interview	Applications are reviewed by a selection committee consisting of the programme director and a nominated member of staff. The main criteria for selection are academic performance to date and academic potential. Applicants are not interviewed.

The programme's competency standards documents can be found at: <http://www.imperial.ac.uk/electrical-engineering/study/undergraduate/applicants-with-disabilities/>

Learning & Teaching Approach

Learning and Teaching Delivery Methods

Learning through scheduled teaching is achieved by means of a range of approaches, such as Lectures, Problem solving Classes and laboratory sessions.

Lectures illustrate new concepts and theoretical materials, while problem solving classes clarify the application of such ideas to specific instances of problems. A blend of these two delivery methods is also possible. Some modules include interactive group activities and formative assessments in the form of quizzes.

Delivery methods include in person teaching, remote synchronous teaching and asynchronous teaching, with pre-recorded lectures delivered through videos followed by in person sessions for discussion. Most lectures and practical work involve student engagement and you are expected to contribute to the discussion with peers, academic and technical staff during your lectures, practical work in problem solving classes, and laboratories.

Throughout the programme there are many opportunities for you to work on your own as well as part of a team in group work; experiences which test your communication, leadership, and interpersonal skills as well as your technical competence, time, and project management skills are developed throughout the programme.

Learning and practical application of the skills acquired is achieved through software and hardware laboratory experiences. These will be introduced within the relevant modules and you will be supported in your learning and proficiency of these by academic staff and Graduate Teaching Assistants.

Individual Research Projects led by industry are also possible, upon agreement with an internal supervisor and the MSc Programme Director.

You will be working on a research project of your choice, (or self-proposed upon approval from the MSc Director) and supervised by one or more members of our academic staff, who are leaders of international renown in their field of research. This will allow you to undertake in-depth research in areas of interest to you, be exposed to state-of-the-art knowledge and develop the communication skills to effectively present your research findings and deliver a research output that contributes to knowledge.

Independent learning

Students are expected to spend significant time on independent study outside of face-to-face contact time.

There is a prerequisite amount of independent study hours for each module which can be augmented based on

your needs. This time will typically be used to access allocated reading material, review lecture notes and recordings, work on individual and group assignments and coursework as well as to revise for tests and examinations. It is essential that you manage your time effectively to meet your learning needs.

Overall Workload

The total expected workload is of 2250 hours for the whole year. You are expected to spend around 20% of time on lectures, seminars and tutorial sessions and 80% of time on Individual study. The latter is further split between Project work and Exams related study. As these are indicative study times, you may need to make reasonable adjustments to these suggested times to account for your individual learning style.

Assessment Strategy

Assessment Methods

A range of summative and formative assessment methods are utilised throughout the course to maximise student learning. Summative assessment refers to those that will test whether you have met the intended learning outcomes of each module and contribute towards the programme-level intended learning outcomes. Formative assessments are designed for you to identify your areas of strength and weakness to enhance your learning.

Assessment methods include Written Examinations, Coursework Assessment, Final Year Project evaluation and Final Project Poster Presentation.

Written examinations are held in December, for a limited set of subjects identified in the module specifications, and normally in May, after the end of the taught component of each module.

Coursework assessment takes place continuously, throughout the year, in parallel to the delivery of the modules, and serves the purpose of enhancing comprehension and critical appraisal of the tools explained through lectures and seminars. The amount of Coursework assessment varies according to your selection of elective subjects. Most subjects have a 25% Coursework component, but some are 100% Coursework based or entirely Examination based.

The Individual Research Project is evaluated on the quality of the submitted report, its originality and technical contribution, the independence shown by you and through a poster presentation.

The exact balance of the summative assessment across the programme depends upon your choice of elective modules, but an indicative breakdown is:

Coursework	50%
Exams	40%
Practical	10%

Academic Feedback Policy

The Department of Electrical and Electronic Engineering recognises that feedback is an essential part of learning and gives high priority to the timeliness and quality of feedback offered to you on all modules. The primary purpose of feedback is to assist learning and the development of skills, by highlighting strengths and weaknesses on one hand, and by identifying actions for improvement on the other. It is important to recognize that: 1) feedback comes in various forms and 2) feedback requires your active engagement.

Feedback will be provided for all assessments carried out as part of your MSc programme. For examinations, the published model answers will be annotated to highlight the common mistakes, and alternate approaches to the solutions. For coursework and the laboratory-based exercises, written feedback will normally be provided within two working weeks of submission. For the research project, feedback will be provided by the supervisor(s) on a continuous basis during the regular project supervision meetings. Oral feedback on the research project will be provided immediately by assessors during/after the poster presentation.

Some of the modules will further aim to provide you with the opportunity to receive feedback ahead of any major summative assessment. Such feedback may be provided in the form of in-class quizzes, problem sheets, etc. You should keep in mind that not all feedback is structured, and important feedback may be obtained from self-reflection on your progress to date, from peers when studying or working together in a team, in dialogue with a lecturer in or outside of a class or laboratory, or by email.

The Board of Examiners will meet to consider the results of the examinations and the research project in mid-late October and results will be released to you only via student e-service within 10 days. Students who have not managed a clear pass will be informed, setting out possible courses of action within 10 days of the examiner's board.

You will meet with your personal tutors to discuss ongoing progression through the programme, exams, research project and career aims.

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 ¹					
Year 1 – FHEQ Level 7					
Students choose, in addition to the two core modules, a total of 8 modules which includes 4 Elective modules from Group A, 3 Electives from Group B, and 1 module from Group (C). Students will be guided by their personal tutors in their choice of elective modules.					
Code	Module Title	Core/ Elective/ Compulsory	Group	Term	Credits
ELEC70089	Control Engineering	Elective	A	Autumn	5
ELEC70006	Design of Linear Multivariable Control Systems	Elective	A	Spring	5
ELEC70090	Digital Control Systems	Elective	A	Spring	5
ELEC70091	Stability and Control of Non-linear Systems	Elective	A	Autumn	5
ELEC70098	Optimisation	Elective	A	Autumn	5
ELEC70028	Predictive Control	Elective	A	Spring	5
ELEC70092	Systems Identification and Learning	Elective	A	Autumn	5
ELEC70009	Discrete-Event Systems	Elective	B	Spring	5
ELEC70048	Probability and Stochastic Processes	Elective	B	Autumn	5
ELEC70022	Modelling and Control of Multi-body Mechanical Systems	Elective	B	Autumn	5
ELEC70074	Power System Dynamics, Stability and Control	Elective	B	Spring	5
ELEC70086	Topics in Control Systems	Elective	B	Spring	5
ELEC70065	Optimal Control	Elective	B	Spring	5
ELEC70066	Advanced Optimisation	Elective	B	Spring	5
ELEC70039	Wavelets, Representation Learning and their Applications	Elective	C	Autumn	5
ELEC70067	Traffic Theory & Queuing Systems	Elective	C	Spring	5
ELEC70096	Coding Theory	Elective	C	Autumn	5
ELEC70070	Information Theory	Elective	C	Spring	5
ELEC70072	Real-time Digital Signal Processing	Elective	C	Spring	5
ELEC70073	Computer Vision and Pattern Recognition	Elective	C	Spring	5
ELEC70096	C1 Lab	Core		Autumn	10
ELEC70097	Individual Research Project	Core		Spring	40
Credit Total					90

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.

Classification of Postgraduate Taught Awards

Award of a Postgraduate Certificate (PG cert):

To qualify for the award of a Postgraduate Certificate, a student must have accumulated at least 30 ECTS credits at Level 7 or above.

Award of a Postgraduate Diploma (PG Dip):

To qualify for the award of a Postgraduate Diploma a student must have:

- a) accumulated at least 60 ECTS credits at Level 7 or above
- b) no more than 10 credits as a Compensated Pass.

Award of a Postgraduate Degree (MSc):

To qualify for the award of a postgraduate degree a student must have:

1. accumulated credit to the value of no fewer than 90 credits at level 7 or above
2. and no more than 10 credits as a Compensated Pass as this programme is accredited by the Institution of Engineering and Technology.

Classification of Postgraduate Taught Awards

The College sets the class of Degree that may be awarded as follows:

1. Distinction: The student has achieved an overall weighted average of 70.00% or above across the programme.
2. Merit: The student has achieved an overall weighted average of above 60.00% but less than 70.00%.
3. Pass: The student has achieved an overall weighted average of 50.00% but less than 60.00%.
 - a. For a Masters, students must achieve a distinction (70.00%) mark in the dissertation or designated final major project (as designated in the programme specification) in order to be awarded a distinction.
 - b. For a Masters, students must achieve a minimum of a merit (60.00%) mark in the dissertation or designated final major project (as designated in the programme specification) in order to be awarded a merit.

Programme Specific Regulations

The accreditation body (IET) requires no more than 10 ECTS credits as compensated pass.

Supporting Information

The Programme Handbook is available at: <https://www.imperial.ac.uk/electrical-engineering/study/current-students-course-handbook/>

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:
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
Curriculum Review	Programmes Committee	22/03/22	PC.2021.56