Imperial College London

Programme Specification (2024-25)

Programme Information		
Programme Title	Programme Code	HECoS Code
Applied Machine Learning	I460	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	N/A	N/A	60	120
PG Certificate	N/A	N/A	N/A	30	60
The PG Certificate and the PG Diploma are exit awards and are not available for entry. You 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 & Electronic Engineering
Associateship	Diploma of Imperial College (DIC)	Main Location(s) of Study	South Kensington Campus
External Reference			
Relevant QAA Benchmark Statement(s) and/or other external reference points		Master's Awards in Engineering	
FHEQ Level		Level 7 - Master's	
EHEA Level		2nd Cycle	
External Accreditor(s) (if applicable)			
External Accreditor 1:	The Institution of Engineering and Technology (IET)		
Accreditation received:	N/A	Accreditation renewal:	2025
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 Krystian Mikolajczyk
Student cohorts covered by specification	2024-25 entry
Date of introduction of programme	October 2020
Date of programme specification/revision	January 2024

Programme Overview

This MSc programme will provide essential training and skills to design, implement and evaluate machine learning systems in several application domains (robotics, communication, speech and vision). It will be delivered within the Department of Electrical and Electronic Engineering.

The programme consists of compulsory taught modules that provide general background theory, practical knowledge and skills (classical Machine Learning and Deep Learning), elective modules focusing on machine learning applied in engineering domains and delivered by internationally leading experts in their respective research fields (robotics, communication, speech and vision) and elective modules that allow you to broaden your experience with other applications of machine learning (AI, neuroscience and signal processing). The modules have a coursework component with the majority of the elective application modules assessed by coursework only. A significant component of the programme is an individual project which is an opportunity to apply the knowledge and skills in a practical problem.

The programme is structured in three parts. The taught component of the programme is delivered in two parts, during the Autumn and Spring Terms. In the Autumn term you will acquire core and compulsory knowledge in the topics of fundamental importance to machine learning whereas in the Spring Term the programme content is more applied and shows how your core and compulsory knowledge can be used to address machine learning challenges and problems. During the third part of the programme, to build on your modules previously studied, you will work on your individual research project. 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 programme is intended for graduates in broad electrical and electronic engineering domains with substantial mathematics and engineering content that require machine learning knowledge and skills.

Most industries working with large amounts of sensors that produce data have recognized the value of machine learning technology. By intelligent processing of the data, organizations are able to offer new products with enhanced capabilities, optimize their processes and gain an advantage over competitors. These include manufacturing, communications, creative industries, health care, energy management, transportation etc. The data analysis and modelling aspects of machine learning are important tools to optimise and automise processes that most industries and services rely on.

During this programme, you will focus on applying machine learning to electrical engineering. Applications include robotics, computer vision bio-inspired learning, communication and signal processing. This course is intended for graduates interested in developing real-world systems. These will involve signals, sensors and hardware, such as robots or communication devices.

Learning Outcomes

Upon successful completion of the programme you will be able to:

1. Apply fundamental concepts and theoretical principles of machine learning for building signal and data

representations and modelling target functions;

2. Develop insight into the problems involved in applying a variety of machine learning techniques (such as neural networks, etc.) to deal with practical scenarios;
3. Critically analyse suitable EEE tasks to which ML techniques can be applied;
4. Formulate practical EEE problems as machine learning tasks;
5. Calculate theoretical values of a learning model given input data and parameters;
6. Analyse and compare the strengths and weaknesses of popular approaches;
7. Design and implement various algorithms in a range of EEE applications through specific programming environments;
8. Predict potential outcomes of applying various types of techniques to a given problem;
9. Create data from various sensors for training modern machine learning models;
10. Evaluate the effectiveness of a particular implementation through appropriate design and execution of experiments;
11. Analyse and document evaluation results, draw appropriate conclusions and recommend actions to improve the performance.

ILOs 1-5 are for all awards (PG Certificate, PG Diploma, MSc degree)

In addition, the PG Diploma requires 6-9, and all ILOs are for MSc degree.

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	The minimum requirement is a 1st Class Honours degree in broad electrical and electronic engineering with substantial mathematics and engineering content, from a UK academic institution or equivalent from an overseas university. The entry requirement for these students is an overall degree total of 87.5%+. The entry requirements for a Chinese student studying in the UK on a 2+2 Programme would be a 1st class degree with a minimum final year mark of 75%. Up-to-date entry requirements: can be found at: www.imperial.ac.uk/electrical-engineering/study/postgraduate/ Given the entry requirements to the programme, all admitted students will have knowledge and skills of programming, though we appreciate this will be in a variety of languages; provision will be made to ensure all students are able to translate their knowledge to the Python programming language. Online tutorials will be recommended at the beginning of the course. Offers made to students are initiated by the MSc Director and another

	member of staff closely related to the programme. When an applicant has a lesser degree qualification but has at least 3 years of work experience, exceptionally a special case for admission can be made; few such applications are made. For further information on entry requirements, please go to: www.imperial.ac.uk/study/apply/postgraduate-taught/entry-requirements/accepted-qualifications/
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 document is available from the department.	

Learning & Teaching Approach

You will experience different learning and teaching delivery methods that most likely include:

The learning and teaching approach consists of a combination of lectures, seminars, computer-based work, coursework and guided reading. It is most likely to include:

- **Lectures:** are typically delivered to the entire cohort ranging from 1-2 hours in length as timetabled. Lectures will be delivered as traditional style lectures, flipped classroom, online learning supported through pre-recorded lectures. Most lectures involve student engagement with questions posed to the class and, in others, a lecturer may include small-group exercises or discussions to reinforce learning of the recently covered material.
- **Quizzes:** these will be deployed in some modules where you will have the opportunity of testing your knowledge through short exercises and quizzes. These exercises are used as part of formative learning and practice; for you to test your understanding of concepts taught and your ability to build on and apply that knowledge.
- **Software development exercises:** are to train you in the use of specialist programming environments, supported by an online discussion forum and team of GTAs to assist you in your learning.
- **Laboratory:** you will be collaborating with other students in small group projects developing small hardware with sensors and a Machine Learning approach in a self proposed application. This is set to reinforce your learning and understanding of the hardware, signal, data, processing and ML decision making.
- **Individual Research Project:** You will be working on a research project of your choice, 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.

As part of the learning and teaching delivery you will be encouraged to be creative in the art of communication in both written and oral presentations, and during the programme you will be challenged to produce different types of output for assessment that rely on your communication skills. These include group/individual coursework report, programming code, lab report, an individual research dissertation and a research poster

presentation.

Development of professional skills is supported by various aspects of the group and individual research project. You will be encouraged throughout the programme to undertake independent reading both to supplement and consolidate material relevant to the lectures and project and to broaden your individual knowledge and understanding of the machine learning area.

Intellectual skills are developed through the teaching and learning methods, with some experience of team work. Practical skills are developed through our teaching and learning programme. Practical computational skills are developed through coursework and project work and through interaction with research supervisor(s) and (sometimes) research students.

Skills related to critical appraisal of machine learning algorithms and analysis of results are taught by guided reading with feedback associated with the group as well as individual project. Transferable skills are developed through Lab group projects, coursework and individual project work.

Overall Workload
Your overall workload consists of face-to-face sessions and independent learning. While your actual contact hours may vary according to the elective modules you choose to study, the following gives an indication of how much time you will need to allocate to different activities at each level of the programme. At Imperial College London, each ECTS credit taken equates to an expected total study time of 25 hours. Therefore, the expected total study time is 2,250 hours per year for an average student.

The Department expects you to allocate approximately 4 hours in self-study for every hour spent in lectures and tutorials for a typical lecture-based module.

The pattern of work is greatly dependent on your selected elective modules, however, on average you can expect to spend about 200 hours in lectures over the autumn and spring terms, while devoting a further 800 hours to independent study. You will spend approximately 250 hours for your laboratory experiments. You will also be expected to spend 1,000 hours on research work for your Individual Research Project, starting from the spring term but full time from May until early September.

Assessment Strategy

Assessment Methods

This programme will employ both summative and formative assessments to support and assess your learning. The goal of the summative assessment is to award a grade against a set of criteria, which includes forms of written exams, coursework, laboratory work, written reports and oral presentation. The formative assessment is designed to support you to better perform in your summative assessment to meet the learning outcomes of the programme.

Assessment of the knowledge base is through a combination of unseen written examinations and assessed coursework. Assessment of intellectual, practical and transferable skills is through coursework and supervised project work. The individual research project is evaluated on the quality of the submitted report, its originality and technical contribution, the independence shown by the student 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

Written feedback will be available through Blackboard normally within 10 working days of the submission of coursework assignment.

This will be in the form of, for example:

- Marked-up coursework, laboratory exercises or tests
- Personal discussion
- Discussions in small-group tutorials
- Verbal presentation, e.g. during or after lectures
- Written class-wide summaries

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

Formative feedback is implemented in form of quizzes during lectures, after which you can see the correct answers and the percentage of cohort votes for each option. In Applied Machine Learning lab, formative feedback is given every other week by the module leaders during the presentations of the progress by each project group.

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/about/governance/academic-governance/academic-policy/exams-and-assessment/
Mitigating Circumstances Policy
The College's Policy on Mitigating Circumstances is available at: www.imperial.ac.uk/about/governance/academic-governance/academic-policy/exams-and-assessment/

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,
Modules in Machine Learning, Deep Learning, and Artificial Intelligence are Level 7 modules which will be co-taught with equivalent Level 6 modules for UG students, with additional Level 7 Learning outcomes applied.

You will study all core and compulsory modules from group A.

You will choose FIVE elective modules from group B.

You will be guided by your personal tutors to choose half of the required number of the elective modules in each term.

Code	Module Title	Core/ Compulsory/ Elective	Group	Term	Credits
ELEC70060	Laboratory in Applied Machine Learning	Core	A	Autumn	10
ELEC70063	Individual Project in Applied Machine Learning	Core	A	Spring-Summer	40
ELEC70059	Machine Learning	Compulsory	A	Autumn	5
ELEC70061	Deep Learning	Compulsory	A	Spring	5
ELEC7_new	AML Devices	Compulsory	A	Spring	5
ELEC70001	Adaptive Signal Processing and Machine Intelligence	Elective	B	Spring	5
ELEC70037	Topics in Large Dimensional Data Processing	Elective	B	Autumn	5
ELEC70039	Wavelets, Representation Learning and their Applications	Elective	B	Autumn	5
ELEC70048	Probability and Stochastic Processes	Elective	B	Autumn	5
ELEC70066	Applied Advanced Optimisation	Elective	B	Spring	5
ELEC70068	Machine Reasoning	Elective	B	Autumn	5
ELEC70071	Self-Organising Multi-Agent Systems	Elective	B	Autumn	5
ELEC70073	Computer Vision and Pattern Recognition	Elective	B	Spring	5
ELEC70078	Digital Image Processing	Elective	B	Autumn	5
ELEC70080	Speech Processing	Elective	B	Spring	5

[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.

ELEC70082	Distributed Optimisation and Learning	Elective	B	Spring	5
ELEC70086	Topics in Control Systems	Elective	B	Spring	5
ELEC70098	Optimisation	Elective	B	Autumn	5
ELEC70109	Advanced Deep Learning Systems	Elective	B	Spring	5
ELEC70110	Neuroscience for Machine Learners	Elective	B	Autumn	5
				Credit Total	90

Progression and Classification

Award of a Postgraduate Certificate (PG Cert)
To qualify for the award of a postgraduate certificate you must have a minimum of 30 credits at Level 7

Award of a Postgraduate Diploma (PG Dip)
To qualify for the award of a postgraduate diploma you must have passed modules to the value of no fewer than 60 credits at Level 7:

1. and no more than 10 credits as a Compensated Pass;

Award of a Masters Degree
To qualify for the award of a postgraduate degree you 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;

Classification of Postgraduate Taught Awards
The College sets the class of Degree that may be awarded as follows:

1. Distinction: 70.00% or above.
2. Merit: 60.00% or above but less than 70.00%.
3. Pass: 50.00% or above but less than 60.00%.

For a Masters, your classification will be determined through the weighted average mark in the designated 'taught' and 'research' aspects of the programme each meeting the threshold for the relevant classification band.

ELEC70060 Laboratory in Applied Machine Learning is a P/F module and does not count towards the programme average.

Your degree algorithm provides an appropriate and reliable summary of your performance against the programme learning outcomes. It reflects the design, delivery, and structure of your programme without unduly over-emphasising particular aspects.

Programme Specific Regulations

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

Supporting Information
The Programme Handbook is available from the department.
The Module Handbook is available at: intranet.ee.ic.ac.uk/electricalengineering/eecourses_t4/index.asp
The College's entry requirements for postgraduate programmes can be found at: www.imperial.ac.uk/study/apply/postgraduate-taught/entry-requirements/accepted-qualifications/
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 you may reasonably be expected to achieve and demonstrate if you take 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.