Imperial College London

Programme Information

Programme Title		Programme Code	HECoS Code
Security and Resilience: Science and Technology		F3C12 / F3C24 / F3SD12 / F3SD24 / F3SR / F3SR24	For Registry Use Only

Award	Length of Study	Mode of Study	Entry Point(s)	Total Credits	
				ECTS	CATS
MSc – F3SR / F3SR24	12 months full-time / 24 months part-time	Full-time / Part-time	Annually in October	90	180
PG Diploma – F3SD12 / F3SD24	12 months full-time / 24 months part-time	Full-time / Part-time	Annually in October*	60	120
PG Certificate – F3C12 / F3C24	12 months full-time / 24 months part-time	Full time / Part-time	Annually in October*	30	60

*The PG Diploma and PG Certificate may be offered to students on the MSc programme at the discretion of the Board of Examiners. Students may also apply to the PG Diploma and PG Certificate upon entry.

Ownership

Awarding Institution	Imperial College London	Faculty	Faculty of Natural Sciences
Teaching Institution	Imperial College London	Department	Physics
Associateship	Royal College of Science	Main Location(s) of Study	South Kensington Campus

External Reference

Relevant QAA Benchmark Statement(s) and/or other external reference points	N/A
FHEQ Level	Level 7 - Masters
EHEA Level	2nd Cycle

External Accreditor(s) (if applicable)

External Accreditor 1:	N/A		
Accreditation received:	N/A	Accreditation renewal:	N/A

Collaborative Provision

Collaborative partner	Collaboration type	Agreement effective date	Agreement expiry date

N/A	N/A	N/A	N/A

Specification Details	
Programme Lead	Dr William Proud
Student cohorts covered by specification	2022-23
Date of introduction of programme	October 2019
Date of programme specification/revision	May 2023

Programme Overview

Security and Resilience are of increasing importance on a world basis. The importance of secure cyber-, cyber-physical and physical protection coupled with an increased awareness and importance of deep-rooted societal and organisational resilience will be the hallmarks of the post-COVID world. While some areas of the world have experienced growth and/or unprecedented peace, e.g., China and Western Europe, there are many polities which are not experiencing such a desirable period. The major changes experienced from the early 1980's where electronic and information technologies gained widespread public access to the small handheld computers, Apps, Internet of Things of the present day are truly breath-taking. The growth in speed, interconnectivity and access to information is unprecedented. Globalisation and liberalisation of markets and movement of people has further changed the societal landscape but also introduced new areas of populism and nationalism into the political narrative.

These MSc, PGDip, and PGCert programmes are designed and developed in line with the research and research activities of the Institute of Security Science and Technology (ISST): a cross-faculty institute involving engineers and natural scientists.

Resilience can be defined as the ability of a society and its organisations to accommodate 'stress' through an understanding of risk. Societal stress can arise due to changes in natural environment, political unrest, physical threat, financial crisis and information leakage. In general security is used to mitigate and remove threat to vital societal structures, both physical and psychological. This course will, through the use of vignettes, cover acts of human intervention, large-scale accidents, and systematic effects, and discuss these in terms of prevention and mitigation post-event.

Areas such as financial security, transportation, and cyber threats, as well as more 'traditional' areas such as physical environment and physical threat are addressed. Additionally, the research methodologies, both qualitative and quantitative, are discussed with significant reference to studying human cognition and behaviour. This aspect is often missing from many STEM courses in the physical sciences and engineering. However, many resilience and security aspects depend strongly on an understanding of human-machine and human-human interactions. The vital role of behavioural science in security endeavours is a key element of this course.

The *Security in Context* module brings the technical, engineering and science aspects together. It outlines, through a series of vignettes and interaction with practising security professionals, the relevance and applications of the concepts in the compulsory and core modules of the programme and places the elective components in context. The needs and effects of political decisions and regulatory process is brought out in this module.

This programme is significantly different to other security courses on offer at competitor institutions. Many security courses tend to focus on policy aspects, often in an exclusively qualitative manner, without referencing a quantitative STEM framework or a clear connection between technology, research and the limits of policy. Conversely, risk analysis tends to towards a 'simple' numeric solution lacking insight into the human condition. This programme will deliberately position itself at the interface between these viewpoints and also address issues of implementation and physical limitations. Themes of science and technology, human activity and

application to society are established first, as the course pushes into areas of policy.

This programme is primarily aimed at taking STEM-educated graduates and providing them with the fundamental conceptual tools and technologies to address the wide-range of these issues from a human, technical and development perspective. Graduates from this programme will be equipped to undertake further research or seek employment in any one of the appropriate areas of government, academia and industry. Furthermore, the programme will equip students to consider the pursuit of entrepreneurial STEM concepts and develop their own exploitable ideas.

Candidates without a STEM background but with significant relevant experience will be considered for entry to this programme. The part-time option is available to students and organisations who need to balance between employment and study.

Students applying for the MSc are required to complete all compulsory modules and two elective modules plus the Long Summer Project. Elective modules can be taken from several Departments including Physics, Mathematics, Computing and Civil and Environmental Engineering. To give students the widest possible choice of electives, students may choose a combination of electives (*either* two 5 ECTS modules *or* one 5 ECTS and one 7.5 ECTS module) that leads to either a total of 90 ECTS or 92.5 ECTS overall for the programme. All elective choices are subject to availability and may have maximum student numbers fixed by the appropriate host department.

Students applying for the PG Diploma are required to complete all compulsory modules, the Short Project and one elective module.

Students applying for the PG Certificate are required to study a sub-set of the compulsory modules. The precise module choice will be made under the advice and guidance of the course director.

Learning Outcomes

At the conclusion of the MSc Security and Resilience: Science and Technology, you will be able to:

- critically analyse wide and complex scenarios based on a broad knowledge and understanding of security and resilience
- define and analyse security in terms of factors such as: behavioural science, social, environmental, infrastructure, communication and information;
- use appropriate statistical and data analysis tools;
- critically examine and implement security system engineering as applied to complex situations and the development of new products and processes;
- apply entrepreneurship, innovation and business techniques for taking new products to market, and critically evaluate the practical, legal and technical constraints;
- implement techniques to evaluate and undertake practical research in developing strategies to deal with complex security and resilience issues;
- critically evaluate a range of technical and policy solutions to select optimal combinations and balance quantitative and qualitative considerations for decision making;
- plan and undertake a major independent research project;
- critically select from a range of strategies and tools to ensure that research designs meet the ethical standards required of human subject studies where necessary;
- communicate effectively to a range of audiences using a variety of media;
- manage teams and demonstrate leadership in both technical and business domains.

At the conclusion of the PG Diploma[1] you will be able to:

- demonstrate and critically analyse based on a broad knowledge and understanding of security and resilience define and analyse security in terms of factors such as: behavioural science, social, environmental, infrastructure, communication and information;
- use appropriate statistical and data analysis tools;
- critically examine security system engineering as applied to complex situations;
- implement techniques to evaluate and undertake practical research in developing strategies to deal

with complex security and resilience issues;
- critically evaluate a range of technical and policy solutions to select optimal combinations and balance quantitative and qualitative considerations for decision making;
- plan and undertake a supervised research project;
- critically select from a range of strategies and tools to ensure that research designs meet the ethical standards required of human subject studies where necessary;
- communicate effectively to a range of audiences using a variety of media;
- demonstrate leadership in technical domains.

At the conclusion of the PG Certificate[1] you will be able to:

- demonstrate and critically analyse complex situations based on knowledge and understanding of security and resilience define and analyse security in terms of factors such as: behavioural science, social, environmental, infrastructure, communication and information;
- understand the appropriate statistical and data analysis tools;
- examine security system engineering as applied to complex situations
- understand a range of technical and policy solutions to select optimal combinations, and balance quantitative and qualitative considerations for decision making;
- critically select from a range of strategies and tools to ensure that ethical standards required of human subject studies are implemented where necessary;
- communicate effectively to a range of audiences using a variety of media.

[1]The PG Diploma and PG Certificate may be offered to students on the MSc programme at the discretion of the Board of Examiners. Students may also apply to the PG Diploma and PG Certificate upon entry.

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 normally a 2:1 Class UK Bachelor's Degree with Honours in a relevant engineering, mathematical or physical sciences discipline (or a comparable qualification recognised by the College) For further information on entry requirements, please go to www.imperial.ac.uk/study/pg/apply/requirements/pgacademic
Non-academic Requirements	N/A
English Language Requirement	Standard requirement (PG) Please check for other Accepted English Qualifications
Admissions Test/Interview	Interviews will be conducted with those applicants who do not possess a STEM background, in order to assess suitability both form the course perspective and the applicants requirements.

The programme's competency standards documents can be found at:
https://www.imperial.ac.uk/media/imperial-college/faculty-of-natural-sciences/department-of-physics/public/students/current-students/pgt/FoNS-Competence-Standards---Physics-PGT.pdf

Learning & Teaching Approach

Learning and Teaching Delivery Methods
A variety of teaching methods are used in the programme, tailored to the particular learning outcomes of each module, including:

- Lectures

- Laboratory work
- Computational exercises
- Workshops and case studies
- Individual project work
- Group work

In all cases formative and summative feedback will be given where appropriate. There is significant group work involved to reflect the realities of current practice. While lectures are used primarily as a context-enhancing process and introduction to critical analysis, tutorials allow for group discussion and wide-ranging questions. A combination of individual and group work on projects and presentations will probe the depth of learning achieved through the reading and discussion of module-relevant articles and case-studies.

Overall Workload

At Imperial, each ECTS credit taken equates to an expected total study time of 25 hours. Therefore, the expected total study time is 2,250 to 2312.5 hours per year for the MSc (90-92.5 ECTS), 1,500 hours per year for the PG Diploma, and 750 hours for the PG Certificate.

Your overall workload consists of face-to-face sessions and independent learning. While your actual contact hours and learning experience may vary according to the elective modules you choose to study, the following gives a general indication of how much time you will need to allocate to different activities at each level of the programme.

MSc students can expect to spend approximately:
- 200 hours attending lectures
- 250 hours in tutorials, supervisions and small group sessions
- 250 hours on extended group projects
- 200 hours on data-analysis, reporting and reviewing
- 750 hours on the Long Summer Project
- 500 hours in other independent study

PG Diploma students can expect to spend approximately:
- 200 hours attending lectures
- 250 hours in tutorials, supervisions and small group sessions
- 225 hours on extended group projects
- 200 hours on data-analysis, reporting and reviewing
- 125 hours on the Short Project
- 500 hours in other independent study

PG Certificate students …:
- 150 hours attending lectures
- 100 hours in tutorials, supervisions and small group sessions
- 100 hours on extended group projects
- 100 hours on data-analysis, reporting and reviewing
- 300 hours in other independent study

Assessment Strategy

Assessment Methods

A variety of assessment methods will be used, reflecting the variety of skills taught and the different learning styles of the students. Written examinations, oral examinations, problems sheets, individual and team presentations are all used. This ensures a wide range of competencies are assessed.

Where module assessment methods are shared with other programmes, the module assessment will reflect the needs of all the programmes.

While individual modules may vary, a typical breakdown of the overall grade for a module is:
- 20% on coursework (e.g., problem sets), feedback will be provided which will be predominantly formative
- 10% on practical exercises, including communication and presentations; feedback will be provided which will be predominantly formative
- 70% by formal examination. Feedback here will be predominantly summative

In modules without a final written examination, there is normally a final report or thesis and summative feedback given.

Academic Feedback Policy

Students receive regular formative feedback from the problem classes, short project and group exercises. Summative feedback will predominantly come from end of module reports and exams

The format of feedback given to individuals or groups will take the form of a short written statement, giving the major points of note in combination with more detailed oral feedback. Follow-up meetings where individuals or groups will be given a more detailed summary can be arranged if needed, focussing on key learning outcomes and module content.

The timescale for feedback follows the guidelines of the Department of Physics, where feedback should be provided to the student within ten working days of the work being submitted.

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]

FHEQ Level 7
Students on the MSc programme are required to complete all compulsory modules, two elective modules and the (core) Long Summer Project. Students on the PG Diploma are required to complete all compulsory modules, the Short Project and one elective module. Students on the PG Certificate are required to study a sub-set of the compulsory modules with the precise module choice made under the advice and guidance of the programme director. Students that engage in the course part time will agree their modules with the course director and when they will be taken over the two-year period.

Code	Module Title	Core/ Compulsory/ Elective/	Group	Term	Credits
PHYS70038	Security in Context	Compulsory		1	7.5
PHYS70036	Behavioural Science and Security	Compulsory		1	7.5
PHYS70037	CBRNE: The Physical Threat Space	Compulsory		1	7.5
PHYS70048	Infrastructure and Transport Security*	Compulsory		1	7.5
PHYS70035	Behavioural Research Methods	Compulsory		2	7.5
COMP60015	Network and Web Security**	Compulsory		2	5
PHYS70039	Sensors: Electronic and Natural	Compulsory		2	7.5
PHYS70042	Global Challenges: Security Entrepreneurship	Elective		2	7.5
PHYS70043	Introduction to Shock Physics	Elective		2	5
	Electives from other Departments, including Physics, Mathematics, Computing, and Civil and Environmental Engineering (at discretion of the Programme Director).	Elective		1, 2	5 or 7.5
PHYS70040	Short Project	Elective (MSc) Compulsory (PGDip)		2	5
PHYS70041	Long Summer Project	Core (MSc)		3	30
				Credit Total	90 or 92.5

*Taught through Department of Civil and Environmental Engineering
**Level 6 module, taught through Department of Computing

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[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.

Progression and Classification

Award and Classification for Postgraduate Students
Degree classification is based on assessment results from each of the modules you complete. These results are combined, weighted by ECTS relative to the total ECTS credits taken (either 90 or 92.5 ECTS for the MSc).

Award of the MSc degree
To qualify for the award of an MSc degree a student must have:
1. accumulated at least 90 ECTS credits at Level 6 or above, which must include a minimum of 75 ECTS credits at Level 7, and up to a maximum of 15 ECTS credits at Level 6;
2. and no more than 15 ECTS 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:
    a. The student has achieved an overall weighted average of 70.00% or above across the programme.
    b. Students must normally achieve a distinction (70.00%) mark in the long summer project in order to be awarded a distinction.

2. Merit:
    a. The student has achieved an overall weighted average of above 60.00% but less than 70.00%.
    b. Students must normally achieve a minimum of a merit (60.00%) mark in the long summer project in order to be awarded a merit.

3. Pass: The student has achieved an overall weighted average of 50.00% but less than 60.00%.

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 6 or above, which must include a minimum of 20 ECTS credits at Level 7, and up to a maximum of 10 ECTS credits at Level 6 where this is approved as part of the award.

Award of a Postgraduate Diploma (PG Dip)
To qualify for the award of a Postgraduate Diploma a student must have:
- accumulated at least 60 ECTS credits at Level 6 or above, which must include a minimum of 45 ECTS credits at Level 7, and up to a maximum of 15 ECTS credits at Level 6 where this is approved as part of the award;
- and no more than 10 ECTS credits as a Compensated Pass.

Programme Specific Regulations

N/A

Supporting Information
The Programme Handbook is available at: www.imperial.ac.uk/physics/students/current-students/taught-postgraduates/
The Module Handbook is available at: https://www.imperial.ac.uk/media/imperial-college/institute-for-security-science-and-technology/MSc-SRST-Handbook-AY22-23-Final.pdf
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	25/01/2022	PC.2021.39
Update to PG Dip Structure	Programmes Committee	11/05/2023	PC.2022.CA20