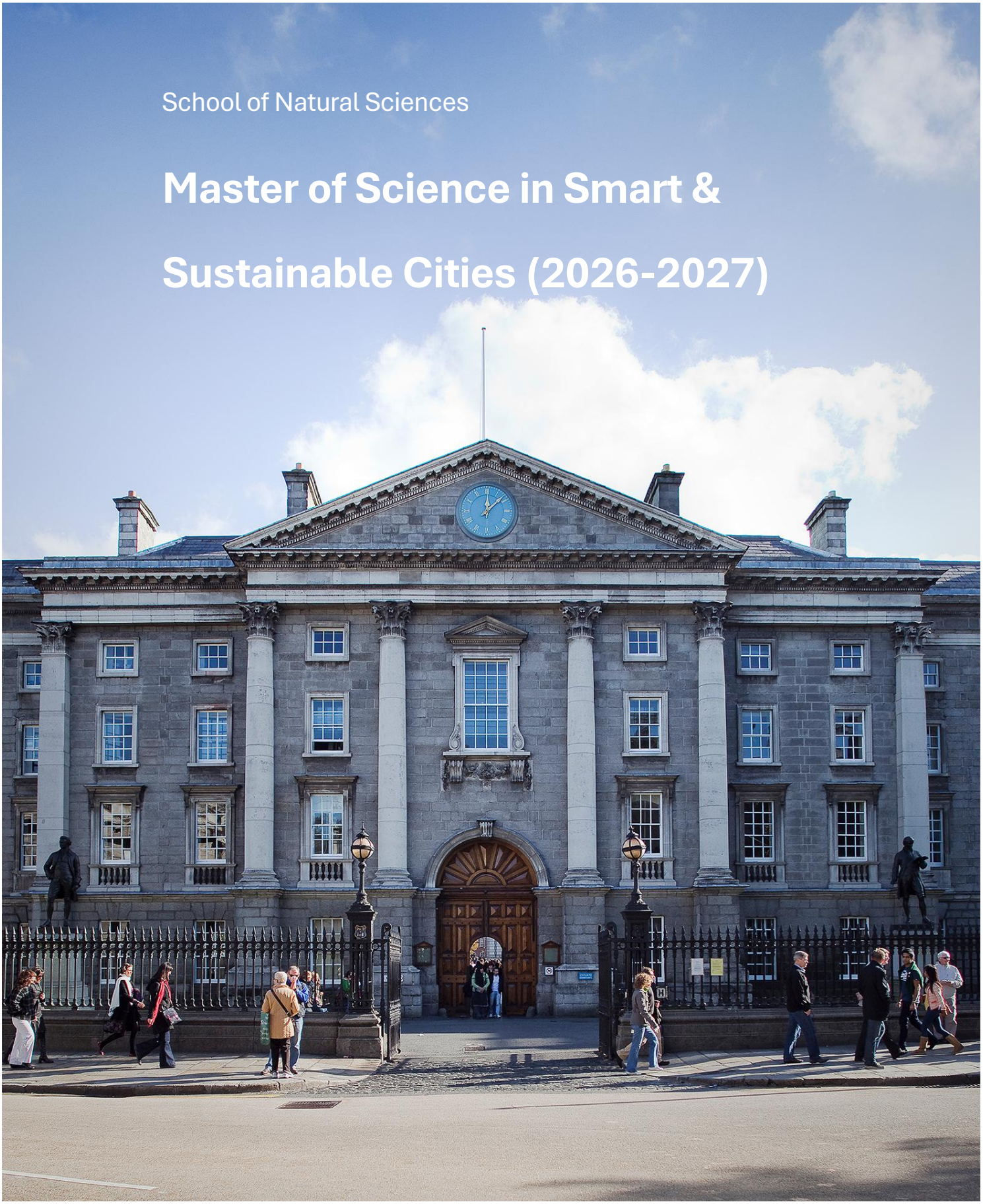
Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

School of Natural Sciences

Master of Science in Smart & Sustainable Cities (2026-2027)



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Welcome

With thousands of smart-city initiatives around the world, smart urbanism is now one of the dominant models of urban development. Projects for smart cities involve the regeneration of existing urban areas as well as the creation of large new settlements, and have a major positive impact on the many environmental, social and economic systems that underpin the planet. Meanwhile, and with a strong overlap with smart city initiatives, cities around the world are reacting to broader environmental challenges, such as climate change through measures aimed at developing sustainable solutions.

Smart-city initiatives have a multi-dimensional nature. As projects that are aimed at improving urban spaces, they are deeply connected to issues of urbanisation and urban planning. Moreover, projects for smart cities involve the production of a number of technologies such as wireless sensor networks designed to produce data on how the city operates, and innovative efficient or low-waste electrical grids. Therefore, because of their focus on technological innovation, the development of smart cities goes beyond the science of the city and is also the product of studies in computer science and engineering. Finally, once implemented, smart interventions take place not upon a blank canvas, but rather within complex ecological and social systems whose dynamics must be taken into account, in order to avoid environmental degradation and biodiversity loss.

Particularly in terms of sustainability, the multi-dimensional nature of smart-city initiatives can be understood only through an interdisciplinary approach. This new MSc in Smart and Sustainable Cities approaches the study of smart and sustainable urbanism by drawing from the research-based expertise of leading scholars from Trinity's Energy, Environment and Emerging Technologies Institute (E3). The programme, which is the first dedicated programme of its kind, will provide students with an in-depth understanding of smart and sustainable cities, using (a) the tools of urban geography and planning to examine the spatial formation of smart cities; (b) methods in engineering and computer science to analyze the functions and applications of smart technologies, and (c) insights from ecology to explore the environmental impact of both 'smart city projects' and wider transformations of contemporary cities. The programme is thus of interest to a wide range of students from different backgrounds. Career options after graduation include working in planning and in the private sector engaged in smart city initiatives.

Dr. Philip Lawton, Course Director

Foreword

This booklet contains contact information on the module coordinators and other personnel associated with the programme; an outline of the course and module structure; key deliverables and milestones; and general information on requirements and expectations.
The full timetable for each semester will be available via the my.tcd.ie portal.

The course comprises 8 compulsory modules (including fieldtrip, carrying 5 ECTS credits and a Placement, which carries 10 ECTS) and a Dissertation module, carrying 30 ECTS credits. In addition, students also take a total of 15 ECTS of optional credits, to give a total 90 ECTS for the course

Students will have access to all library facilities in TCD, including the Freeman Library in the Museum Building. Students are encouraged to avail of all resources and materials locally and online.

Students are required to secure an appropriate supervisor for their dissertation. Supervisors can be drawn from across all faculties in TCD. Students should identify an appropriate supervisor on the basis of the topic they have selected, and their general research interests in consultation with the module coordinator.

Contact

Course Director: Dr. Philip Lawton at philip.lawton@tcd.ie

Postgraduate Admin Coordinator: Elaine Elders at elderse@tcd.ie

Although the information in this handbook is correct at the time of production, the precise content of the course is subject to change. While every effort will be made to give due notice of major changes, the School Office reserves the right to suspend, alter or initiate courses, timetables, examinations and regulations at any time.

Governance Structure

Course Committee:

This committee has responsibility, in conjunction with the Head of the School of Natural Sciences, for the day to day running of the programme and for its future development. The committee participates in the implementation of and compliance with the TCD Quality Assurance procedures and assists in the periodic reviews of the programme. This committee reports into the Graduate Studies committee.

Membership of the Course Committee:

Ex officio members:

Course Director (Dr. Philip Lawton)

School Director of Teaching and Learning (Postgraduate)

Head of School of Natural Sciences

Course Administrator

All module coordinators

Student representative

Module Coordinators (Core Courses)

Name	Background	Module
Dr. Philip Lawton (Director)	Philip Lawton joined Trinity College Dublin as Assistant Professor in Geography in September, 2017. His research interests are focused on the intersection between urban economic change, urban policy making and social life in cities. Outputs from his research have included the analysis of residential preferences of creative-knowledge workers (*Cities*, 2013), the ideal of the 'European city' in Dublin policy making (*International Journal of Urban and Regional Research*, 2014), and the connections between uneven development and suburban transformation in Adamstown, Dublin (*European Journal of Urban and Regional Studies*, 2018). Prior to joining Trinity College, Philip held positions in Maynooth University, NUI Galway, and Maastricht University. Through these experiences,	Course director Module coordinator for Urban Governance, Fieldtrip, Placement and Dissertation

	Philip has sought to develop an approach to teaching that is centred on student discussion and interaction.	
Dr Federico Cugurullo	Federico Cugurullo is Assistant Professor in Smart and Sustainable Urbanism at Trinity College Dublin. His research is positioned at the intersection of urban geography, political philosophy and experimental urbanism, and explores how ideas of sustainability are cultivated and implemented across geographical spaces, with a focus on projects for eco-cities and smart cities. Federico has done extensive empirical research in the Middle East and Southeast Asia where he has investigated the sustainability performance of supposedly experimental cities such as Masdar City in Abu Dhabi and Hong Kong. His work has been used by the United Nations and the United Kingdom's Department for Environment, Food & Rural Affairs (DEFRA) to foresee future urban challenges and develop preventive policies. Building upon empirical grounds, Federico's main theoretical aspiration (also the subject of his forthcoming book) is the development of urban equations for a sustainable urbanism. Other theoretical contributions include the concept of urban eco-modernisation, and the theory of de-composed urbanism and Frankenstein cities. Before joining Trinity College Dublin, Federico held positions at the University of Manchester, King's College London and the London School of Economics and Political Science.	Module coordinator for Smart-eco Cities of the Future
Dr. Giovanni Di Liberto	Giovanni received his Bachelor's degree in Information Engineering in 2011 and his Master's degree in Computer Engineering in 2013, both from the University of Padova, Italy. After a period working on his thesis at University College Cork (UCC, Ireland), he joined Edmund Lalor's research lab in Trinity College Dublin where he pursued a PhD in auditory neuroscience in the School of Electronic and Electrical Engineering. He received his PhD in 2017 and he joined the Laboratoire des Systèmes Perceptifs at École Normale Superieure (Paris) immediately after, under the supervision of Alain de Cheveigné and Shihab Shamma. He holds the title of Assistant Professor in Intelligent Systems in the School of Computer Science and Statistics at Trinity College Dublin. Giovanni's scientific interests centre on understanding the brain mechanisms underlying speech comprehension. In his work, he develops data analysis methods and applies them to brain data to identify the neural processes responsible for the transformation of a sensory stimulus into its abstract	Module coordinator for Introduction to Machine Learning module

	meaning. Brain electrical data is measured with either non-invasive (e.g., electroencephalography - EEG) or invasive (e.g., electrocorticography - ECoG) technologies. The first aspect of his research is methodological and has produced novel experimental and analysis frameworks to investigate cortical auditory processing. The second aspect of his research is to use such novel methods to test theories on auditory perception, such as the hierarchical processing of speech and predictive processing theories (e.g. predictive coding). Finally, the third part of his work is translational and involves the identification of solutions to utilise his novel methods in applied settings, for example as tools to develop brain-computer interfaces (COCOHA project) or as objective measures for the monitoring of language development and healthy ageing.	
Prof. Padraig Carmody	Pádraig Carmody is a Professor in Geography at TCD, from which he holds both a B.A. in Geography and History and M.Sc in Geography. He completed his Ph.D in Geography from the University of Minnesota in 1998. Subsequently he taught at the University of Vermont, Dublin City University, and St. Patrick's College, Drumcondra. He also worked as a policy and research analyst for the Combat Poverty Agency in 2002-2003. His research centres on the political economy of globalization in Africa. His teaching interests are in development and economic geography. He has taught both undergraduate and graduate classes on Africa, third world development and globalization, in additional to human environment relations and regional development.	Module coordinator for Approaches in Smart & Sustainable Cities
Dr. John Connolly	Dr. John Connolly is The Kinsella Assistant Professor in Geographical Information Systems and Remote Sensing and leads the Trinity Geospatial Research Group. He joined Trinity College Dublin in September 2020. He teaches GIS and remote sensing at both undergraduate and postgraduate levels. John's research uses GIS and Earth Observation to study the terrestrial environment including land use change; landscape carbon dynamics; solar mapping and habitat assessment using EO.	John will take a role in the GIS course which will be led by Dr. Jean Wilson (see below)
Dr. Jean Wilson	Dr Jean Wilson is a Postgraduate Teaching Fellow in the School of Natural Sciences. Jean's research interests centre on environmental applications of remote sensing, GIS and spatial analysis, specifically in the context of water resources monitoring and management. Her research was funded from 2009 - 2018 under the EPA STRIVE initiative. She has developed novel methodologies in the application of thermal remote sensing and geochemical tracing techniques for localising and assessing groundwater discharge to lakes and coastal waters nationally.	Module coordinator for Research Methods GIS & Environmental Policies
Dr. Marcus Collier	Professor Collier's many research interests include land use and land-use change, resilience thinking and societal transitioning, collaborative management and	Module coordinator for Urban Sustainability Module

	planning, urban and rural governance. Notable examples of his research include the contentious policy issues of biomass/bioenergy land-use policies and implications, afforestation policies and acidification processes, field boundaries and agri-environmental change, resource use and after-use policies, rewilding, GM crops and biodiversity, marine and coastal governance, (cultural) ecosystem services, and well-being. In recent years he has researched and published extensively on contested issues such as novel ecosystems and nature-based solutions.	

Affiliated Staff (Optional Modules)

The MSc in Smart and Sustainable Cities also draws upon the expertise of a number of modules delivered via participating schools and programmes. The following list is of staff members associated with respective available courses. Please note, when selecting optional modules, please ensure you keep in good communication with the relevant module coordinator.

Name	School	Module
Professor Sarah Mc Cormack sarah.mccormack@tcd.ie	School of Engineering, Civil, Structural and Environmental Engineering	CE7J04 – Energy Policy & Energy Storage
Professor Douglas Leith leithdo@tcd.ie	School of Computer Science and Statistics	CS7CS4 – Machine Learning
Dr. Susan Murphy susan.p.murphy@tcd.ie	School of Natural Science, Geography	DP7023 – Climate Change: Science, Development and Justice
Dr Mélanie Bouroche bourocm@tcd.ie	School of Computer Science and Statistics	CS7NS4 – Urban Computing
Dr Bidisha Ghosh bghosh@tcd.ie	School of Engineering, Civil, Structural and Environmental Engineering	CE7T01 – Transportation Policy
Dr Ivana Dusparic Ivana.Dusparic@tcd.ie	School of Computer Science and Statistics	CS7IS2 – Artificial Intelligence
Dr. Jean Wilson wilsonj1@tcd.ie	School of Natural Science	ES7027 – Environmental Policies
Dr. Rosie Mangan romangan@tcd.ie	School of Natural Science, Botany	BD7056 – Human Interactions with Biodiversity
Dr John Gallagher J.Gallagher@tcd.ie	School of Engineering, Civil, Structural and Environmental Engineering	CEPCAE03 – Climate Adaptation Engineering Challenge

Academic Year Structure

Find the full academic year structure 2025-26 here: academic-year-structure.pdf

Dates to note:

Event(s)	Date(s)
Semester one starts	14th September 2026
Semester one ends	4th December 2026
Semester two starts	18th January 2027
Semester two ends	9th April 2027
Publication of results	Final results published in October after the Court of Examiners
Reassessment Examinations	Week 52 - beginning 23rd August 2027
Publication of Reassessment results	Final results published in October after the Court of Examiners

Requirements and expectations

Attendance:

Prompt attendance for **all** taught components, including fieldtrip, placement and dissertation preparation, is a requirement of this course. Prior permission for absence should be sought *in writing* from the module co-ordinator. *Failure to attend classes is regarded as a failure to comply with the fundamental course requirements.* For modules and projects that include field work, students are required to read the safety guidelines (available online at http://www.tcd.ie/estatesandfacilities/health-and-safety/). In addition to attending a safety briefing, students are required to complete health and safety forms and insurance forms.

The course aims to develop key transferable skills of both independent work and working together as part of a group. For group work, it is essential that students participate fully with assigned groups; take the initiative and do not leave it to others. Group work will be subject to peer group assessment.

This is a post-graduate qualification and therefore contains a considerable component of independent study. It is vital that students effectively manage the time spent outside of classes. The course structure assumes a nominal 40 to 50 hour week, although there will inevitably be some variability of workload throughout the year.

IMPORTANT: non-attendance due to paid employment is not an acceptable excuse or mitigating circumstance.

Code of conduct

All students are expected to comply with the TCD student code of conduct. Students are expected to be courteous and professional at all times, and in their dealings with all persons connected to the programme. Failure to do so will result in disciplinary action. Inappropriate or unprofessional conduct will be brought to the attention of the course committee and appropriate penalties will be applied. Additional information is available from the college website. It is the student's responsibility to familiarise themselves with this information and ensure that all standards are maintained at all times throughout the programme.

https://www.tcd.ie/Junior_Dean/student-discipline/

On top of the normal college regulations, students are reminded that they are professionals, who, throughout the year, will be engaging with fellow professionals – such as on the Fieldtrip and during the placement. It is expected that students act accordingly in these situations.

Overall Course Objectives/ Learning Outcomes

Programme Aims, Objectives, and Learning Outcomes

On successful completion of the course students should be able to:

- Explain the drivers, nature and evolution of smart and sustainable urbanism as a
- modality of urbanisation.
- Analyse big data sets using technical tools to enable the better planning of cities.
- Develop integrated plans to deliver smart and sustainable city interventions.
- Deploy their excellent practical understanding of Geographic Information Systems to
- deliver improvements to urban efficiency and sustainability.
- Apply their advanced level understanding of ecology and the potential for nature-based
- solutions to urban problems.
- Effectively design, develop and deliver independent research focused on key elements
- of smart and sustainable urbanization.

Description of the European Credit Transfer System

The European Credit Transfer and Accumulation System (ECTS) is an academic credit system based on the estimated student workload required to achieve the objectives of a module or programme of study. It is designed to enable academic recognition for periods of study, to facilitate student mobility and credit accumulation and transfer. The ECTS is the recommended credit system for higher education in Ireland and across the European Higher Education Area. The ECTS weighting for a module is a measure of the student input or workload required for that module, based on factors such as the number of contact hours, the number and length of written or verbally presented assessment exercises, class preparation and private study time, laboratory classes, examinations, clinical attendance, professional training placements, and so on as appropriate. There is no intrinsic relationship between the credit volume of a module and its level of difficulty. The European norm for full-time study over one academic year is 60 credits.

1 ECTS credit represents 20-25 hours estimated student input, so a 5-credit module will be designed to require 100-125 hours of student input including class contact time and assessments. ECTS credits are awarded to a student only upon successful completion of the course year.

Course Structure and Modules

The programme will run over a twelve-month period and will consist of several modules in different disciplines, with the aim of capturing the many different dimensions of the smart city. Modules in urban geography and sustainable urban development will address the urban dimension of smart cities, including their social dimensions and approaches to urban governance. Modules in computer sciences, simulation and engineering, will analyse how the latest smart technologies operate. Modules in ecology and environmental geography will examine the impact that smart-city projects have on local, regional and global environmental systems.

Sustainability will be a crosscutting theme and will permeate the entire degree with the aim of exploring solutions to real-life urban issues and developing strategies for truly ecological and socially just cities. The programme will be highly interdisciplinary and students will study smart urbanism, by combining the methodological and conceptual tools of different, compatible disciplines.

Module list:

Core Modules

Semester 1	Semester 2
GG7001 – Urban Governance (5 ECTS)	GG7007 – Research Methods: GIS (5 ECTS)
CSP7000 – Intro to Machine Learning (5 ECTS)	GG7002 – Urban Sustainability (5 ECTS)
GG7008 – Approaches in Smart & Sustainable Cities (5 ECTS)	DP8017 – Smart Eco-Cities of the Future (5 ECTS)
	GG7009 – Placement (10 ECTS)
	GG7005 – Fieldtrip (5 ECTS)
	GG7006 – Dissertation (30 ECTS)

Optional Modules - select 15 ECTS in total (3 modules)

Semester 1	Semester 2
CE7J04 – Energy Policy & Energy Storage (5 ECTS)	CS7IS2 – Artificial Intelligence (5 ECTS)*
CS7CS4 – Machine Learning* (5 ECTS)	ES7027 – Environmental Policies (5 ECTS)
DP7023 – Climate Change: Science, Development & Justice (5 ECTS)	BD7056 – Human Interactions with Biodiversity (5 ECTS)
CS7NS4 – Urban Computing (5 ECTS)*	CEPCAE03 – Climate Adaptation Engineering Challenge (5 ECTS)
CE7T01 – Transportation Policy (5 ECTS)	

check handbook for prerequisites

Core Module Structure

Michaelmas Term – Semester 1

Module code	Module title	ECTS	Term
	Module Coordinator	ICA/CW/FE	
GG7001	Urban Governance	5	Michaelmas
Core	Phil Lawton	100% CW	
CSP7000	Introduction to Machine Learning	5	Michaelmas
Core	Giovanni Di Liberto	60% CW 40% ICA	
GG7008	Approaches in Smart & Sustainable Cities	5	Michaelmas
Core	Pádraig Carmody	100% CW	
CE7J04	Energy Policy & Energy Storage	5	Michaelmas
Optional	Sarah McCormack	25% CW, 75% FE	
CS7CS4	Machine Learning	5	Michaelmas
Optional	Douglas Leith	100% CW	
DP7023	Climate Change: Science, Development & Justice	5	Michaelmas
Optional	Susan Murphy	100% CW	
CS7NS4	Urban Computing	5	Michaelmas
Optional	Mélanie Bouroche	60% CW, 40% FE	
CE7T01	Transportation Policy	5	Michaelmas
Optional	Bidisha Ghosh	10% CW, 90% FE	

ICA = In course Assessment – Formal Assessment in exam conditions

CW = Coursework

FE = Formal Examination in Annual Examination Period

Hilary Term – Semester 2

Module code	Module title Module Coordinator	ECTS ICA/CW/FE	Term
GG7007 Core	Research Method GIS Jean Wilson	5 100% CW	Hilary
GG7002 Core	Urban Sustainability Marcus Collier	5 100% CW	Hilary
DP8017 Core	Smart Eco-Cities of the Future Federico Cugurullo	5 100% CW	Hilary
GG7009 Core	Placement Philip Lawton	10 100% CW	Hilary
GG7005 Core	Fieldtrip Philip Lawton	5 100% CW	Hilary
GG7006 Core	Dissertation Philip Lawton	30 100% CW	Hilary
CS7IS2 Optional	Artificial Intelligence Ivana Dusparic	5 100% CW	Hilary
ES7027 Optional	Environmental Policies Jean Wilson	5 100%	Hilary
BD7056 Optional	Human Interactions with Biodiversity Rosie Mangan	5 100% CW	Hilary
CEPCAE03 Optional	Climate Adaptation Engineering Challenge John Gallagher	5 100% CW	Hilary

ICA = In course Assessment – Formal Assessment in exam conditions

CW = Coursework

FE = Formal Examination in Annual Examination Period

Collaboration with industry partners for placements

The course will incorporate a mandatory industrial in-company placement module. The placement is designed to allow students to link their in-class learning to hands-on approaches within a particular sub-area of smart cities and urban sustainability. This will be achieved both through the experience of the work placement itself and through the completion of a report, which will form the majority of the coursework on this module (80%). As well as improving the potential learning outcomes for the students, this will also allow for the development of long-term professional relations between the Masters and key industry partners. Students will be expected to seek out and secure their own placements. However, students will be given assistance in finding relevant organizations.

Fieldtrip

A central pillar of the Masters is a residential fieldtrip, which will allow students to relate the themes and concepts from the Masters to everyday examples in different contexts. A novel aspect of this module will be the encouragement of student-led learning via the development and delivery of an original piece of research revolving around a particular theme. The fieldtrip will alternate between three European cities that have been central to both smart and sustainable approaches to urban transformations. This allows students to gain insights into the ways in which different approaches emerge within specific social, political and economic contexts in which they are embedded. The destination for the Fieldtrip for 2026-2027 is Amsterdam. Students will need to budget an additional 500-600 Euros for the Fieldtrip. Also, the Fieldtrip will take place during Reading week in semester 2 (week beginning Monday 1st March 2027). In TCD, the Reading Week in Semester 2 is often used for the purposes of a Fieldtrip.

International students, or those who do not have a Schengen visa already, will need to apply for one through VFS Global Book an appointment | vfsglobal. This can take a number of months, so the application process should be started as soon as possible. Please note, you will need to have your IRP number before applying for the visa. Any queries on the application process can be directed to snsglobal@tcd.ie

Module descriptors

Semester 1 – Core

Module Code	GG7001
Module Name	Urban Governance
ECTS Weighting[1]	5 ECTS
Semester taught	Semester 1
Module Coordinator/s	Dr. Philip Lawton
Module Learning Outcomes	The key learning objectives for this module are as follows: to gain an in-depth knowledge of the meanings of urban governance structures for the everyday workings of contemporary cities; to understand the intertwining of social and political forces in shaping everyday urban environments; to enhance the critical reading and writing skills of students, with a particular focus on urban theory. **Module learning outcomes** On successful completion of the module students should be able to: • Explain the linkage between the nature of cities and the history of urbanization. • Explain the complexity of social and political forces at work in urban space. • Engage critically with the role of urban theory and how it can be applied to real-world solutions. • Develop and hone critical skills in reading and writing across different research areas and traditions.
Module Content	This module will introduce students to the role of urban governance in shaping contemporary urban space. The module will promote an understanding amongst students of the complex forces that serve to bring about processes of urbanization. Here, in drawing upon relevant examples, the module will begin through an analysis of the different forces at work in shaping urban space, including economic, social, cultural and political dynamics. Upon completion of this section of the module, the students will have knowledge of the inter-relationship between governance structures and the wider dynamics of urban change. This will include both 'smart' and 'sustainable' approaches to governing urban space, but this specific focus will also be expanded upon within the 'Smart EcoCities of the Future' course.

[1] TEP Glossary

Teaching and Learning Methods	The module draws upon the Problem-Based Learning approach (PBL) to allow students to link debates in urban theory with real-world examples.

Assessment Details[2]

Assessment Component	Assessment Description	LO Addressed	% of total	Week due
Continuous Assessment	Submission of problem-based learning exercises		30%	
Continuous Assessment	Term Assignment (Details in second week of class)		70%	

Reassessment Requirements	**Independent Study (preparation for course and review of materials, this includes flipped classroom tutorials):**
	Independent Study (preparation for assessment, incl. completion of assessment):
Contact Hours and Indicative Student Workload[4]	**Contact hours:** 20 hours
Recommended Reading List	None
Module Pre-requisite	
Module Co-requisite	
Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.	No

[2] TEP Guidelines on Workload and Assessment

Module Code	CSP7000
Module Name	Introduction to Machine Learning
ECTS Weighting[3]	5 ECTS
Semester taught	Semester 1
Module Coordinator/s	Giovanni Di Liberto
Module Learning Outcomes	On successful completion of this module, students should be able to: Programme learning outcomes PLO2: Analyse big data sets using technical tools to enable the better planning of cities. PLO3: Develop integrated plans to deliver smart and sustainable city interventions. PLO6: Effectively design, develop and deliver independent research focused on key elements of smart and sustainable urbanization. Module learning outcomes MLO1 Configure a programming environment suitable for exploring ML techniques MLO2 Prepare datasets for ML processing, visualise the data, and understand the consequences of decisions made in cleaning data MLO3 Assess the performance of a ML pipeline MLO4 Critically evaluate the outputs of a ML pipeline MLO5 Communicate with ML experts and non-experts: Explain goals and requirements of a project, interpret the outcomes of typical ML analyses, present results to non-experts. MLO6 Assess the cost/benefit of distinct ML methodologies and explain what makes one approach more suitable than another one for a given task MLO7. Understand challenges involving data sharing, storage, and privacy **Graduate Attributes: levels of attainment** To act responsibly - Introduced To think independently - Enhanced To develop continuously - Enhanced To communicate effectively - Attained

[3] TEP Glossary

Module Content	Introduction to Machine Learning is designed to offer an introduction to the basics of ML, specifically with a hands-on curriculum aimed at developing knowledge and skills in establishing ML pipelines with state of the art languages and toolkits. This module is designed for students with limited prior experience of programming. It will introduce the fundamentals of programming, with a focus on setting up an effective pipeline for processing datasets to execute common ML techniques such as Support Vector Machines and Linear Regression. Students will be assessed both on the acquired technical skills and on their ability to understand the ML pipeline and results and communicate effectively with experts and non-experts.
Teaching and Learning Methods	Lectures, tutorials, group project, guest lecture/seminar, classroom discussion

Assessment Details[4]

Assessment Component	Assessment Description	LO Addressed	% of total	Week due
Engagement and Communication	Group project presentation	LO2-6	10	Second last week
Technical (coding & ML) skills	Individual laboratory assignments	LO1-4	25	Weeks 3, 6, 9
Communication, presentation, group work	Group assignment (written report)	LO2-7	25	Final week
Written Test	2h written test	LO2-7	40	Final week

Reassessment Requirements	100% written examination
Contact Hours and Indicative Student Workload[4]	**Contact hours:** 28h in total: 14h lectures + 4h tutorials discussion + 3h laboratory Q&A + 3h group project discussion + 2 group project presentations + 2 written test

[4] TEP Guidelines on Workload and Assessment

	Independent Study (preparation for course and review of materials, this includes flipped classroom tutorials): 40h **Independent Study (preparation for assessment, incl. completion of assessment):** 49h
Recommended Reading List	- Python Crash Course: A Hands-On, Project-Based Introduction to Programming, Eric Matthes (eBook available in the TCD library) - Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Aurélien Géron, 2nd Edition, O'Reilly Media (first half of the book)
Module Pre-requisite	None
Module Co-requisite	
Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.	School of Computer Science

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Module Code	GG7008
Module Name	Approaches in Smart and Sustainable Cities
ECTS Weighting[5]	5 ECTS
Semester taught	Semester 1
Module Coordinator/s	Prof Pádraig Carmody

[5] TEP Glossary

Module Learning Outcomes	It should be noted from the outset that it is expected that what you produce for this module will be substantially updated and expanded for your dissertation. • To identify and learn about different approaches within Smart and Sustainable Cities from throughout different disciplines, including Computer Science, Engineering, Natural Science, and Social Science; • To synthesize approaches and results from different approaches across different disciplines; • To understand the requirements of setting up and carrying out a stand-alone research project; • To enable students to develop a focused literature review and initial proposal on a topic related to smart and sustainable cities.
Module Content	This module aims to bring together cutting-edge approaches to Smart and Sustainable Cities. It draws from the top expertise across different schools in Trinity College Dublin, with the ultimate aim of providing an overview of the different approaches to smart and sustainable cities within the framework of E3 and across schools of Computer Science, School of Natural Sciences, and Engineering. Throughout the duration of the semester, different experts within each of the schools will draw out from their own research experience in order to offer key insights into the different ways of conceptualizing and researching smart and sustainable cities. This will include details of setting up and beginning a research project, carrying out the research and subsequently writing up of their findings. The course will be structured as follows: The majority of the course will involve different experts delivering insights on their approach to smart and sustainable cities. For these lectures, different experts will outline their experiences and approaches. A smaller sub-section of the course will be focused upon the development of a literature review and initial proposal as a core element of your wider research approach. This will be delivered by the course coordinator, Prof. Padraig Carmody and Dr Philip Lawton. As is outlined below, the core aim of this part of the course is to demonstrate the link between a body of literature and a wider approach to research. **Link to Dissertation:**

	It is important to note that this module also serves as a way of introducing students to potential topics their dissertation. While it is a stand-alone module, it serves the dual purpose of allowing students to think about their dissertation topic and potentially identify a supervisor (if they have not already done so). Although some students will already have chosen their topic, others can use the time to think through the different approaches in Smart and Sustainable Cities.
Teaching and Learning Methods	Lectures
Assessment Details[6]	

Assessment Component	**Assessment Description**	**LO Addressed**	**% of total**	
Continuous Assessment	**Literature Review (1000 Words):** This involves undertaking a critical analysis of, and write-up of, the key literatures and debates within the sub-area that you will focus upon in your dissertation. As such, it forms a crucial	All	20	

[6] TEP Guidelines on Workload and Assessment

		backbone of your dissertation. In the Literature Review, for this part of the assignment, you are free to engage in the literature that you would like to draw upon for your dissertation.			
	Continuous Assessment	**Dissertation Proposal (2000 Words):** developing a research topic, research question, setting aims and objectives of the thesis	All	80	

Reassessment Requirements

Contact Hours and Indicative Student Workload[4]	**Contact hours:** **Independent Study (preparation for course and review of materials):** **Independent Study (preparation for assessment, incl. completion of written assessment):**
Recommended Reading List	
Module Pre-requisite	N/A
Module Co-requisite	N/A
Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.	No

Semester 2 – Core

Module Code	GG7007
Module Name	Research Methods: GIS
ECTS Weighting[7]	5 ECTS
Semester taught	Semester 2
Module Coordinator/s	Dr Jean Wilson (wilsonj1@tcd.ie)

[7] TEP Glossary

Module Learning Outcomes	**1)** Demonstrate knowledge of GIS as a tool, its principles, and concepts (including the GIS data model, GIS data sources and formats and spatial referencing systems) and GIS terminology **2)** Develop skills in applying GIS to solve real-world problems **3)** Working competency in geospatial data management practices (including GIS data acquisition, storage and editing) **4)** Practical knowledge of modern (cloud-based) GIS practices (e.g. web maps, web apps, dashboards, online surveys, hosted feature layers) **5)** Skills in GIS communication for diverse audiences, including data visualisation and report writing **6)** Cognisance of the inclusive practice of digital accessibility and its relevance to GIS **7)** Demonstrate competency to undertake new (i.e. unfamiliar) GIS analyses.
Module Content	GIS facilitates data-driven strategies for sustainable urban development, contributing to resilient, inclusive, and environmentally friendly cities (Costa et al., 2024). GG7007 introduces students to the fundamental principles, methods, techniques and tools in GIS for spatial analysis including data management visualisation and communication. Following completion of this course students are prepared to think geographically and understand what a GIS comprises and how GIS and spatial analysis can be used to support operational and strategic decision making in the context of Smart and Sustainable Cities.
Teaching and Learning Methods	The course will be delivered through an introductory lecture followed by weekly laboratory (computer-based) practicals using industry standard software namely ESRIs ArcGIS Online (AGOL) and ArcGIS PRO. Additional time outside the labs will be required to complete the assignments and weekly learning activities. Students are required to bring 1) a portable hard drive device (e.g. usb key) with at least 2GB of storage and 2) a hardback notebook (for use as a GIS journal) to class.
Assessment Details[8]	

Assessment Component	Assessment Description	LO Addressed	% of total	Week due

[8] TEP Guidelines on Workload and Assessment

Continuous Assessment 1	Short answer quiz	1	15%	25
Continuous Assessment 2	GIS Journal	2 - 6	15%	Weekly
Continuous Assessment 3	AGOL Final Practical Analysis & Report	5, 7	35%	28
Continuous Assessment 4	PRO Final Analysis & Report	5, 7	35%	33

Reassessment Requirements

N/A

Contact Hours and Indicative Student Workload[4]

Contact hours: 60 in person GIS labs
Independent Study (preparation for course and review of materials, preparation for assessment, incl. completion of written assessment): 40

Recommended Reading List

A specific course book will not be used but students wishing to further their knowledge of GIS fundamentals and ESRI software can review the following resources and many more via the Trinity College Library website:

Costa et al. (2024) Achieving Sustainable Smart Cities through Geospatial Data-Driven Approaches. *Sustainability*, 16(2), 640. https://doi.org/10.3390/su16020640

Funde, P (2022) Getting to know web GIS. Fifth Edition. ESRI Press.

McHaffie et al. (2023) GIS An Introduction to Mapping Technologies, Second Edition. Routledge.

Mitchell, A. (2020) The ESRI Guide to GIS Analysis. ESRI Press.

Rocha, J. et al. (2023) GIS and Spatial Analysis. IntechOPen.

Module Pre-requisite	N/A
Module Co-requisite	N/A
Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.	No

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Module Code	GG7002
Module Name	Urban Sustainability
ECTS Weighting[9]	5 ECTS
Semester taught	Semester 2
Module Coordinator/s	Dr. Marcus Collier
Module Learning Outcomes	**Module learning aims/objectives** • to introduce students to the core tenets of sustainable urban development through the learnings from practice. • to guide students through the development of the UN Sustainable Development Goals and how they can be implemented at different scales, with a focus on the scale of the urban region. • to develop a strong understanding of the intertwining of the social and technical aspects of sustainable urban development. **Module learning outcomes** On successful completion of the module students should be able to:

[9] TEP Glossary

	• develop cognitive skills for assessing an in-depth meanings of urban sustainability in practice. • explain the potentials of sustainable practices and the challenges contained within sustainability-oriented policies (at local, regional, national and global levels).
Module Content	This module will offer students a grounding in core approaches to sustainable urban development through the experiences of professionals and practitioners. The module will first introduce students to the basic tenets of sustainable urban development, with a focus on the interconnections between the ecological, social, economic, and cultural aspects of meanings of sustainability and its significance for understanding urbanization and cities. In drawing upon a range of expertise from practitioners and policy-makers, the module will then explore a range of different examples across the spectrum of urban sustainability. This will include knowledge of grounded approaches, such as through 'nature-based solutions' and their applicability in different contexts; the practices of social sustainability and how it connects to ecological approaches; the role of justice in promoting sustainability; how 'smart' technologies can aid in the development of sustainable practices.
Teaching and Learning Methods	The module consists of a minimum of lectures, mainly it is comprised of 'insight interviews' and class discussions with professionals, policy-makers, and practitioners in diverse areas of urban sustainability. Depending on weather, there may also be a field trip in Dublin.
Assessment Details[10]	

Assessment Component	**Assessment Description**	**LO Addressed**	**% of total**	**Week due**
Continuous Assessment	Core paper based upon student research of a core sustainability issue in a chosen city	All	100%	End March

[10] TEP Guidelines on Workload and Assessment

Reassessment Requirements	Re-assessment, if needed, consists of a research-based essay on a given topic.
Contact Hours and Indicative Student Workload[4]	**Contact hours:** 22h of lectures **Independent Study (preparation for course and review of materials, preparation for assessment, incl. completion of written assessment):**
Recommended Reading List	Journal papers are supplied on Blackboard Rethinking Sustainable Cities Urban Planet
Module Pre-requisite	N/A
Module Co-requisite	N/A
Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.	No

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Module Code	DP8017
Module Name	Smart-eco cities of the future
ECTS Weighting[11]	5 ECTS
Semester taught	Semester 2
Module Coordinator/s	Dr Federico Cugurullo (cugurulf@tcd.ie)

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Module Learning Outcomes	
Module Content	The world is entering an urban age. There is a direct correlation between global development challenges such as climate change, poverty and resource scarcity, and urban issues. The way cities are designed, planned, governed and experienced, has a direct impact not only on local societies, economies and environments, but also on the planet. However, while cities are responsible for the majority of the environmental, social and economic problems of the twenty-first century, they can also be drivers of change and steer the development of nations towards a condition of sustainability. Today, it is clear that current cities have to evolve, but how and when this will happen are questions which are still surrounded by a veil of mystery. In this module, we will examine the main models of sustainable urbanism currently under development across the world. We will learn how projects for smart cities and eco-cities are developed, drawing upon a number of case studies from different continents. We will explore new and existing cities in Southeast Asia, the Middle East and Europe, in order to evaluate how the idea of urban sustainability is cultivated and implemented across geographical spaces, seeking to discover a formula for sustainable city-making. This module is highly interdisciplinary and interactive, and uses the tools of geography, planning, politics and sustainability science to accomplish the following objectives: · Understand and evaluate mainstream models of sustainable urban development such as the smart city and the eco-city · Reflect over the meaning of the idea of urban sustainability · Undertake a critical analysis of projects for smart and eco-cities from a sustainability perspective

Teaching and Learning Methods	
Assessment Details[12]	

Assessment Component	**Assessment Description**	**LO Addressed**	**% of total**	**Week due**
Continuous Assessment	Online test (mix of open and close ended questions)		100%	

Reassessment Requirements	
Contact Hours and Indicative Student Workload[4]	**Contact hours:** 24 Teaching Hour **Independent Study (preparation for course and review of materials, preparation for assessment, incl. completion of written assessment):** 100 hours reading
Recommended Reading List	Cugurullo, F. (2021). Frankenstein urbanism: Eco, smart and autonomous cities, artificial intelligence and the end of the city. Routledge.
Module Pre-requisite	N/A
Module Co-requisite	N/A
Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.	School of Natural Sciences

[12] TEP Guidelines on Workload and Assessment

Module Code	GG7005
Module Name	Residential Fieldtrip
ECTS Weighting[13]	5 ECTS
Semester taught	Semester 2
Module Coordinator/s	Dr. Philip Lawton
Module Learning Outcomes	**Module learning aims/objectives** The core aims of this module are for students to gain direct insights into the workings of different bodies/authorities – local and regional authorities, private companies, social enterprises, community organizations, activist groups – in engaging with smart and sustainable approaches to contemporary cities. As a field-based module, this will be made possible through a hands-on approach that will promote a mix of grounded research, active learning, dialogue, presentations and report writing. **Module learning outcomes** On successful completion of the module students should be able to: • analyse the development and implementation of urban policies in different contexts (London, Amsterdam, Brussels to alternate). • enhance/improve discussion and presentation skills. • improve written and verbal communication skills. • evaluate urban policies through engagement and dialogue with key texts in urban theory and urban policy.
Module Content	The fieldtrip offers students the opportunity to experience application of concepts from both core and optional elements of the course first-hand. Through a visit to a key location (Such as London, Amsterdam, Copenhagen, or other relevant European city), students will be exposed to a range of approaches to both smart and sustainable solutions for urban development. There will be two key elements to the fieldtrip. First, the students will be introduced to a range of key projects in the selected cities (prereading of policy documents, arranged visits, talks), and a grounded piece of group work, with groups selected based upon an the bringing together of complimentary skillsets.

[13] TEP Glossary

Teaching and Learning Methods

Assessment Details[14]

Assessment Component	Assessment Description	LO Addressed	% of total	Week due
Continuous Assessment 1	**Pre-Fieldtrip Outline of Topic:** A: brief outline (max 300 words), covering theme and location in Amsterdam (This will be approved in the days after submission) B: Once theme and location are approved, you will need to submit a 1000 words pre justifying how your case-study/example fits within the themes of smart and/or sustainable cities and giving detail of its links to the relevant theme or topic you are working on		30%	
Continuous Assessment 2	**On-Site Presentation**: PPT presentation or similar– (Maximum slides 10 ppt slides and 15 minutes)		30%	
Continuous Assessment 3	**On-Site Visit**: Site Visit with Discussion and/or discussion with key individual involved in relevant project (c.30 minute on-site visit)		30%	
Continuous Assessment 4	**Peer Response**: You will be asked to lead the questions/discussion with one of your fellow students during the fieldtrip		10%	

[14] TEP Guidelines on Workload and Assessment

Reassessment Requirements	
Contact Hours and Indicative Student Workload[4]	**Contact hours:** **Independent Study (preparation for course and review of materials, preparation for assessment, incl. completion of written assessment):**
Recommended Reading List	•
Module Pre-requisite	N/A
Module Co-requisite	N/A
Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.	School of Natural Sciences

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Module Code	GG7009
Module Name	Placement (In-Company Placement)
ECTS Weighting[15]	10 ECTS
Semester taught	Semester 2

[15] TEP Glossary

Module Coordinator/s	Dr. Philip Lawton
Module Learning Outcomes	**Module learning aims/objectives** The key aim of this module is to develop connections between the different modules and the hands-on approach of different stakeholders within organizations engaging in smart and sustainable approaches to cities. **Module learning outcomes** On successful completion of the module students should be able to: • Explain the applicability of key class-based learnings to real life situations. • enhance their communication skills, both in written and oral formats. • further developed their skillsets within both/or either smart and/or sustainable city tools.
Module Content	The placement offers an opportunity for students to apply the key learnings from the course in a hands-on and practical manner. In working with key industry partners, students will be offered the opportunity to work in a team environment for six weeks. The output from this placement will be the development of a report on a key element or focus of the work being carried out while the student is on placement with the relevant company. It should be noted from the outset that the format of the Placement will depend significantly upon the structure of the organization and the working arrangements of the particular individual/partner involved with the MSc SSC. Thus, while for some students there will be a greater emphasis of 'in-place' operations, for others, the Placement will involve project work that has been pre-arranged with the partner organization.
Teaching and Learning Methods	

Assessment Component	**Assessment Description**	**LO Addressed**	**% of total**	**Week due**
Continuous Assessment 1	Proposal as developed prior to placement		20%	

	Continuous Assessment 2	Final report on experience of placement and its relationship to key elements of MSc in Smart and Sustainable Cities		80%	

*The finalization of these grades is dependent upon the satisfactory completion of placement, including communication from organization or company in which placement takes place that it has been completed in a satisfactory manner. Should students be unable to finish the placement due to illness or similar unforeseen circumstances, they will undertake an alternative piece of work, which will comprise of a systematic literature review on a topic agreed with the course director.

Reassessment Requirements	
Contact Hours and Indicative Student Workload[4]	**Contact hours:** 6 weeks placement **Independent Study (preparation for course and review of materials, preparation for assessment, incl. completion of written assessment):**
Recommended Reading List	•
Module Pre-requisite	N/A
Module Co-requisite	N/A
Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.	School of Natural Sciences

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Module Code	GG7006
Module Name	Dissertation

ECTS Weighting[16]	30 ECTS - Derogation
Semester taught	Semester 2
Module Coordinator/s	Dr. Philip Lawton
	Module learning aims/objectives The core aim of this module is to develop in students a capacity for individual learning through the development of an original piece of research. As such, the key learning aims are as follows: • Development of a research question/research aim. • Moving from research question to a clear outline/proposal. • The carrying out of a piece of research through the development of a clear methodology. • The development of written skills through the completion of a final thesis/dissertation. **Module learning outcomes** On successful completion of the module students should be able to: • develop clear writing skills. • improve critical and analytical skills. • develop key methodological skills, whether qualitative, • quantitative, or a combination of both. • to demonstrate a high level of knowledge of a niche area of research with real-world applicability for relevant industries linked to both/either or smart and sustainable cities.
Module Content	Supervisors can be drawn from various academic staff from across the Schools of Natural Sciences, Computer Science and Statistics, and Engineering and are not confined to those teaching on existing modules. Lists of academic staff in the participating Schools are available here: https://naturalscience.tcd.ie/people/ https://www.scss.tcd.ie/personnel/ https://www.tcd.ie/Engineering/staff/ The dissertation will entail students developing a piece of original research through a grounded and prolonged engagement with a research question from either/or both 'smart' and 'sustainable' approaches to contemporary cities. The students will be able to

[16] TEP Glossary

	draw upon a range of methodological approaches but will be largely dictated through their engagement with earlier modules, such as their choice of methods module.
Teaching and Learning Methods	
Assessment Details[17] •	

Assessment Component	Assessment Description	LO Addressed	% of total	Week due
Continuous Assessment 1	The development of the research proposal and presentation		10%	
Continuous Assessment 2	The development and completion of the final thesis		90%	

Reassessment Requirements	
Contact Hours and Indicative Student Workload[4]	**Contact hours:** **Independent Study (preparation for course and review of materials, preparation for assessment, incl. completion of written assessment):**
Recommended Reading List	•
Module Pre-requisite	N/A
Module Co-requisite	N/A

[17] TEP Guidelines on Workload and Assessment

Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.	School of Natural Sciences

Semester 1 – Optional

Module Code	CE7J04
Module Name	J4: Energy Policy and Energy Storage
ECTS Weighting[18]	5 ECTS
Semester taught	Semester 1
Module Coordinator/s	Prof. Sarah McCormack Other lecturer(s): Prof. Brian Caulfield, Asst. Prof Mohammad Reza Ghaani
Module Learning Outcomes	On successful completion of this module, students should be able to: LO1. Develop and discuss the main areas of energy policy. LO2. Understand requirements for LEED/Zero Energy and Net Passive buildings. LO3. Evaluate energy projects using economic analysis tools. LO4. Compare and evaluate various energy storage technologies in terms of their strengths, limitations, and cost-effectiveness for different energy systems and applications. LO5. Design energy storage systems to support grid stability, integrate renewable energy sources, and optimize energy dispatch and management. LO6. Evaluate the environmental sustainability of energy storage technologies, considering factors like resource utilization, emissions, and end-of-life management. **Graduate Attributes: levels of attainment** To act responsibly - Introduced To think independently - Attained To develop continuously - Enhanced To communicate effectively - Enhanced

[18] TEP Glossary

Module Content	This module is an optional module which runs in the first semester. The module will develop knowledge in current energy policy and our energy storage options. It will include topics in energy economics, policy, energy storage options and circular economy and sustainability in storage systems will be addressed.
Teaching and Learning Methods	Core content via lectures Individual assignments
Assessment Details[19]	

Assessment Component	**Assessment Description**	**LO Addressed**	**% of total**	**Week due**
Continuous Assessment	Energy Storage Project	LO4-6	25%	Week 12
Examination	3 hour examination	ALL	75%	N/A

Reassessment Requirements	Re-assessment, if needed, consists of 100% written examination (3 hours), weighted at 50% to pass
Contact Hours and Indicative Student Workload[4]	**Contact hours:** 30 hours **Independent Study (preparation for course and review of materials):** 20 hours

[19] TEP Guidelines on Workload and Assessment

	Independent Study (preparation for assessment, incl. completion of written assessment): 75 hours
Recommended Reading List	Sustainable energy systems engineering; P Gevorkian (2007) Storing Energy - with Special Reference to Renewable Energy Sources; Trevor Letcher (2022)
Module Pre-requisite	N/A
Module Co-requisite	N/A
Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.	School of Engineering, Civil Structural and Environmental Engineering

Module Code	CS7CS4
Module Name	Machine Learning
ECTS Weighting[20]	5 ECTS
Semester taught	Semester 1
Module Coordinator/s	Professor Douglas Leith

[20] TEP Glossary

Module Learning Outcomes	On successful completion of this module, students will be able to: - Understand what machine learning is and how it works; - Understand and be able to apply machine learning algorithms such as linear regression, logistic regression, SVM, kNN and (deep) neural networks; - Be able to effectively evaluate the performance of machine learning methods; - Apply machine-learning frameworks (e.g. scikit-learn) to solve real-world problems; - Write clear and effective reports to present machine learning results and analysis.
Module Content	1. Prediction using machine learning; 2. Choice of features, including for text, images, time series; 3. Model selection (e.g. linear, kernel, neural net); 4. Learning as empirical risk minimisation; 5. Common machine learning techniques (linear regression, logistic regression, SVMs, kernel trick, neural nets, convolutional neural nets, kNN, k-Means); 6. Evaluating machine learning methods (cross-validation, bootstrapping, ROC, use of a baseline); 7. Practical experience of applying machine learning methods to real data; 8. Experience of writing up machine learning analysis and results as a report.
Teaching and Learning Methods	Lectures and coursework

Assessment Component	Assessment Description	LO Addressed	% of total	Week due
Coursework	Weekly Assignments; Individual Project	LO1-5	100%	

Reassessment Requirements	100% Assignment

Contact Hours and Indicative Student Workload[4]	**Contact hours:** 22 hours Lectures **Independent Study (preparation for course and review of materials, this includes flipped classroom tutorials, preparation for assessment, incl. completion of assessment):** 94 hours
Recommended Reading List	
Module Pre-requisite	*Please note that there are pre-requisite expectations for this course. Any student interested in taking the course must first discuss it with Dr. Philip Lawton. There is an expectation that students undertaking this course will be able to demonstrate previous experience in Machine Learning or similar area. Python programming
Module Co-requisite	
Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.	School of Computer Science

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Module Code	DP7023
Module Name	Climate Change: Science, Development and Justic
ECTS Weighting[21]	5 ECTS
Semester taught	Semester 1
Module Coordinator/s	Dr Conor Buggy (conor.buggy@ucd.ie), Dr. Susan Murphy (susan.p.murphy@tcd.ie)

[21] TEP Glossary

Module Learning Outcomes

Learning Objectives:

This module aims to provide students with the following:

- An understanding of climate change in the context of earth system science, planetary 'tipping points', and the effects of recent anthropogenic activities on climate change;
- An introduction to anticipating (i.e. modelling) the future physical effects of climate change and their societal impacts, particularly with regard to development;
- An understanding of how concerns regarding the impacts of climate change in the developing world came to influence the climate change agenda, and an overview of relevant legislative and policy frameworks concerning climate change at international and national levels (including adaptation and mitigation approaches to dealing with climate change in the developing world);
- A projection of potential climate change impacts to public health;
- Examine and critically assess justice-based issues to which climate change can give rise.

Learning Outcomes:

Having successfully completed this module a student should expect to:

- Understand the concepts of earth system science and planetary boundaries, particularly within the context of recent anthropogenic activity and climate change;
- Be conscious of relevant global climate processes and climate dynamics;
- Be conversant with current relevant climate and development discourses and negotiations;
- Be aware of the main organisations, mechanisms and legislative frameworks through which climate change is being mainstreamed within development strategies at international and national levels;
- Be aware of the potential role of climate in major areas of concern for development workers, including food security, public health, water availability and security;
- Understand concepts and conceptions of justice, human rights, and climate change in the light of sustainable development policy and practice;
- Demonstrate an understanding of climate justice debates;
- Understand the basics of computer-based modelling of climate change and of development-relevant climate change impacts; and
- Be able to communicate effectively the results of their research and project work to a wider audience.

Module Content	This module aims to provide students with an overview of the implications on sustainable development of various aspects of climate change, including social, economic, environmental, and moral dimensions. Students will also examine the strengths and weaknesses of approaches used to anticipate future climate change and its impacts. The science of Earth's systems which influence our climate are introduced and the scientific basis for climate change explored. The module also provides an examination of the moral dimensions of climate justice, human rights and development. Students on the module are, without exception, expected to read widely, to think deeply, to discuss fully and to analyse critically – and to work to a high standard both individually and as part of a group. Information on readings relevant to particular classes/discussions will be circulated in advance.
Teaching and Learning Methods	There will be guest lectures with leading-edge scientific researchers on topic related to climate modelling, measuring ecosystem services, just transitions, and the social and political dynamics of climate policy and actions. Attendance at lectures is mandatory. Participation in the debate is mandatory. A debate protocol will be provided during the course of the module.
Assessment Details[22]	

Assessment Component	Assessment Description	LO Addressed	% of total	Week due
Written Examination	In class 2hour written examination		100%	16
Continuous Assessment 1	Class debate & write up		20%	
Continuous Assessment 2	Debate self-reflection		10%	

Reassessment Requirements	
Contact Hours and Indicative Student Workload[4]	**Contact hours:** 25 to 30 hours teaching; 3 hour debate; 2 hour written examination

[22] TEP Guidelines on Workload and Assessment

	Independent Study (preparation for course and review of materials, preparation for assessment, incl. completion of written assessment): 100 hours reading, specified learning activities (SLA's)
Recommended Reading List	
Module Pre-requisite	N/A
Module Co-requisite	N/A
Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.	School of Natural Sciences

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Module Code	CS7NS4
Module Name	Urban Computing
ECTS Weighting[23]	5 ECTS
Semester taught	Semester 1
Module Coordinator/s	Mélanie Bouroche

[23] TEP Glossary

Module Learning Outcomes	On successful completion of this module, students will be able to: - Describe the purpose, scope, and challenges associated with urban computing; - Describe and reason about cyber-physical systems, including closing the feedback loop; - Describe, compare and contrast existing approaches and associated challenges to data collection and management, including participatory and opportunistic sensing; - Contrast, select and apply state of the art city-scale intelligent optimization techniques; - Analyze, specify, design, implement and test a complete smart city application.
Module Content	This module aims to provide both a theoretical and practical understanding of urban computing and associated cyber-physical concepts, principles, challenges and solutions. Urban computing is a process of acquisition, integration, analysis of and actuation upon, big and heterogeneous data generated by a diversity of sources in urban spaces, to improve the management of constrained urban resources, thereby enhancing the urban environment, human life quality, and city operation. Students will be exposed to the wide range of principles and challenges associated with urban computing, and how ubiquitous sensing, advanced data management and analytic models, and autonomic computing need to come together to address those. The module also aims to highlight some of the relevant ongoing research and innovation in the space taking place within Ireland and internationally. Specific topics addressed in this module include: - Gathering urban data, resources (environment/pollution/energy, human mobility and vehicular traffic, water) monitoring and data mining; - Urban big data management and heterogeneous data management, knowledge fusion across heterogeneous data; - Closing the feedback loop, model/analyze/plan/execute loop and associated requirements and challenges; - Citizen engagement, including participatory and opportunistic sensing; - Urban data visualization and decision support systems; - Anomaly detection and event discovery in urban areas; - Urban-scale ubiquitous/pervasive intelligent systems.

Teaching and Learning Methods	2 lectures per week.

Assessment Details[24]

Assessment Component	Assessment Description	LO Addressed	% of total	Week due
Examination	Online examinations (5 hours)	L01, L02, L03, L04, L05	40%	
Continuous Assessment 1	Group Assignment Smart City Case Study (report and presentation)	L01, L02, L03, L04, L05	15%	Week 4
Continuous Assessment 2	Sensor Data Collection	L01, L03, L05	10%	Week 6
Continuous Assessment 3	Sensor Data Gathering	L01, L03, L05	10%	Week 8
Continuous Assessment 4	Smart City Application	L05	25%	Week 11

Reassessment Requirements	Online exam 100%
Contact Hours and Indicative Student Workload[4]	**Contact hours:** 22 hours Lectures **Independent Study (preparation for course and review of materials, this includes flipped classroom tutorials, preparation for assessment, incl. completion of assessment):** 94 hours
Recommended Reading List	
Module Pre-requisite	** Students must be able to program a front and back end application. **
Module Co-requisite	

[24] TEP Guidelines on Workload and Assessment

Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.	School of Computer Science

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Module Code	CE7T01
Module Name	T1 – Transportation Policy
ECTS Weighting[25]	5 ECTS
Semester taught	Semester 1
Module Coordinator/s	Prof. Bidisha Ghosh (bghosh@tcd.ie) Lecturer(s): Prof. Margaret O'Mahony (Margaret.omahony@tcd.ie) Prof. Brian Caulfield (brian.caulfield@tcd.ie)
Module Learning Outcomes	On successful completion of this module, students should be able to: LO1. Develop an overview of transportation and traffic engineering. LO2. Develop an understanding of queuing models and traffic paradoxes. LO3. Discuss and design the layout of a traffic junction. LO4. Design and evaluate fixed-time traffic signal plan of a junction. LO5. Implement land-use models to manage traffic demand. LO6. Develop knowledge and understanding of urban transportation Management policies. LO7. Evaluate the impact of public transport policies. **Graduate Attributes: levels of attainment** To act responsibly - Enhanced To think independently - Enhanced To develop continuously - Introduced To communicate effectively - Enhanced

[25] TEP Glossary

Module Content	The students will be given an introduction to role of policy in transportation, urban transportation policies, land-use modelling and public transport quality and benchmarking, fundamentals of traffic engineering focusing on junction and traffic signal design, queuing theory, traffic paradoxes, junction design and traffic signal designing.
Teaching and Learning Methods	• Core content via lecture(direct). • Research paper and case study-based group discussion. • Individual Assignments.
Assessment Details[26]	

Assessment Component	**Assessment Description**	**LO Addressed**	**% of total**	**Week due**
Continuous Assessment	Report and group discussion	LO1 LO3 LO4	10%	Week 12
Written Examination	3 hours written examination	LO1-7	90%	End of term

Reassessment Requirements	Re-assessment, if needed, consists of 100% 3 hours written examination
Contact Hours and Indicative Student Workload[4]	**Contact hours:** Lectures 27 hours Directed Learning 15 hours **Independent Study (preparation for course and review of materials):** 55h **Independent Study (preparation for assessment, incl. completion of written assessment):** Assignments 26 hours
Recommended Reading List	O'Flaherty, Coleman A., ed. Transport planning and traffic engineering. CRC Press, 2018.

[26] TEP Guidelines on Workload and Assessment

	Traffic Engineering (What's New in Engineering) by Roger Roess, Elena Prassas & William McShane
Module Pre-requisite	N/A
Module Co-requisite	N/A
Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.	School of Engineering, Civil Structural and Environmental Engineering

Semester 2 – Optional

Module Code	CS7IS2
Module Name	Artificial Intelligence
ECTS Weighting[27]	5 ECTS
Semester taught	Semester 2
Module Coordinator/s	Dr. Ivana Dusparic

[27] TEP Glossary

Module Learning Outcomes	On successful completion of this module, students will be able to: - Appreciate the scope, applications and limitations of artificial intelligence; - Comprehend and apply search, reasoning and planning strategies; - Develop intelligent systems that handle uncertainty; - Choose and use appropriate AI techniques for various kinds of problems; - Apply knowledge search, CSP, MDP, learning techniques to real-world problems; - Gain experience both in working as an individual and in a team on designing and developing solutions utilizing the most appropriate AI techniques; - Gain experience in communicating their AI-based solutions through writing, demonstrations and presentations.
Module Content	This module aims to provide students with a thorough overview of the artificial intelligence techniques and algorithms that underlie intelligent systems and an ability to apply these techniques to real-world problems. Specific topics addressed in this module include: - Search; - Problem solving; - Constraint satisfaction problems; - Markov Decision Process; - Representing and reasoning with uncertainty; - Learning, including reinforcement learning; - Intelligent agents and multi agent systems; - Real-world applications.
Teaching and Learning Methods	Lectures, individual assignments, group assignments.

Assessment Details[28]

Assessment Component	Assessment Description	LO Addressed	% of total	Week due
Continuous Assessment 1	Programming Assignment	LO2, LO3	35%	Week 6

[28] TEP Guidelines on Workload and Assessment

	Continuous Assessment 2	Programming Assignment	LO4, LO5	35%	Week 11
	Continuous Assessment 3	Research Paper (group assignment)	LO1, LO4, LO5, LO6, LO7	30%	Week 12

Reassessment Requirements	Individual Assignment (Including programming and research paper components) – 100%.
Contact Hours and Indicative Student Workload[4]	**Contact hours:** 22 hours Lectures **Independent Study (preparation for course and review of materials, this includes flipped classroom tutorials, preparation for assessment, incl. completion of assessment):** 94 hours
Recommended Reading List	Stuart Russell and Peter Norvig Artificial Intelligence: A Modern Approach, (3rd Edition) 2015 or (4th Edition) 2019. Upper Saddle River (NJ): Prentice Hall.
Module Pre-requisite	Programming proficiency in Python required.
Module Co-requisite	While not required, it would be beneficial to take this module in conjunction with CS7CS4: Machine Learning.
Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.	School of Computer Science

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Module Code	BD7056
Module Name	Human Interactions with Biodiversity
ECTS Weighting[29]	5 ECTS

[29] TEP Glossary

Semester taught	Semester 2
Module Coordinator/s	Dr. Rosie Mangan
Module Learning Outcomes	On successful completion of this module students will be able to: • Demonstrate a critical understanding of the relationships between biodiversity, ecosystem functioning, and the provision of ecosystem services that support human well-being. • Evaluate the principles, applications, and limitations of the natural capital approach in biodiversity conservation and environmental decision-making. • Analyse how biodiversity is integrated into business, policy, and economic systems, including the development of nature-positive strategies and sustainable practices. • Assess the role of multiple stakeholders across sectors in shaping biodiversity outcomes, and apply appropriate communication and engagement strategies. • Critically examine conflicts between biodiversity conservation and human activities, and propose balanced, evidence-based solutions that consider ecological, social, and economic trade-offs. • Synthesize information from diverse sources and communicate complex ideas effectively through written, oral, and collaborative formats.
Module Content	This module explores the interactions between biodiversity and human society, focusing on ecosystem services, natural capital, and their role in policy, business, and conservation. Students examine how different sectors engage with biodiversity and analyse conflicts and trade-offs between conservation goals and human well-being..
Teaching and Learning Methods	

Assessment Details[30]

Assessment Component	Assessment Description	LO Addressed	% of total	Week due
Continuous Assessment 1	Business and biodiversity presentation (group mark)		30%	
Continuous Assessment 2	Conflicts summary		30%	
Continuous Assessment 3	Written article		40%	

Reassessment Requirements

Contact Hours and Indicative Student Workload[4]

Contact hours:
Independent Study (preparation for course and review of materials, preparation for assessment, incl. completion of written assessment):

Recommended Reading List

Module Pre-requisite N/A

Module Co-requisite N/A

Are other Schools/Departments involved in the delivery of this module? If yes, please provide details. School of Natural Sciences

[30] TEP Guidelines on Workload and Assessment

Module Code	ES7027
Module Name	Environmental Policies
ECTS Weighting[31]	5 ECTS
Semester taught	Semester 2
Module Coordinator/s	Dr Jean Wilson
Module Learning Outcomes	On successful completion of this module, following lecture attendance, completion of specified learning activities and the assignments students will be able to: • Demonstrate broad knowledge of environmental law and policy and principles relevant to its application • Describe the legal framework within which environmental law in Ireland operates and identify the scheme of environmental regulation at national, European and International level • Conduct independent and group research to synthesise information for dissemination to stakeholders in written and video format. • Advise management on compliance with the requirements of key environmental legislation, regulation and policy.
Module Content	ES7027 Environmental Policies is designed to provide a high-level overview of environmental law and policy as an introduction to the fundamentals of law that govern how society interacts with the environment. As future environmental scientists, consultants, and conservationists it will be impossible to successfully deliver research or projects without careful attention to the legal framework protecting the environment. The module seeks to provide you with foundations of both theoretical and empirical knowledge of environmental law and policy, as well as equipping you with an understanding of the contemporary debates and critical issues in, and perspectives on, environmental regulation and the science-policy interface.
Teaching and Learning Methods	This module combines lectures and independent study that includes a review and critical synthesis of key literature culminating in a written essay and completion of a short answer quiz. Collaborative groupwork will be undertaken in the form of inquiry / cooperative project-based learning to foster effective oral, written and digital literacy, peer interaction and teamwork.

[31] TEP Glossary

Assessment Details[32]

Assessment Component	Assessment Description	LO Addressed	% of total	Week due
Continuous Assessment 1	Essay		55%	26
Continuous Assessment 2	Short answer quiz		15%	28
Continuous Assessment 3	Group work (report and video presentation)		30%	33

Reassessment Requirements

Students must resubmit failed coursework for marking.

Contact Hours and Indicative Student Workload[4]

Contact hours: **24 lecture hours**
Independent Study (preparation for course and review of materials, preparation for assessment, incl. completion of written assessment): 80 hours

Recommended Reading List

Learning materials, recommended reading and academic writing resources (in support of essay writing and groupwork) are provided as course content on blackboard.

Module Pre-requisite

N/A

Module Co-requisite

N/A

Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.

School of Natural Sciences

[32] TEP Guidelines on Workload and Assessment

Module Code	CEPCAE03
Module Name	Climate Adaptation Engineering Challenge
ECTS Weighting[33]	5 ECTS
Semester taught	Semester 2
Module Coordinator/s	John Gallagher (J.Gallagher@tcd.ie)
Module Learning Outcomes	On successful completion of this module, students should be able to: LO1: Develop problem-solving and critical thinking skills to support your ability to work through complex, real-world climate adaption challenges and produce innovative solutions. LO2: Collaborate in transdisciplinary teams and settings, fostering good communication and respect to ensure all different perspectives are considered. LO3: Combine interdisciplinary knowledge from stakeholders with different backgrounds to address a complex climate adaption challenge. LO4: Increase capacity to acquire new information from research and peer-to-peer knowledge sharing on the climate adaption topic to increase literacy skills and enable more informed outputs. LO5: Enhance professional standards of writing and presenting evidence to support climate adaption findings.
Module Content	This module immerses students in a real-world, multidisciplinary group challenge focused on climate adaptation within the built environment. Using a case study approach aligned with current European research agendas (e.g., Horizon Europe), students will engage with a specified urban district facing climate-related vulnerabilities. The module guides students through the full project lifecycle: from identifying climate adaptation challenges to proposing strategic, evidence-based, and stakeholder-informed solutions. Students will collaboratively: • Develop a shared problem statement and team project strategy; • Conduct a comprehensive literature review and knowledge mapping exercise exploring technical, economic, environmental, social, and governance factors;

[33] TEP Glossary

- Design a robust, interdisciplinary project concept addressing their identified problem, complete with impact analysis, stakeholder strategy, and implementation plan;
- Deliver a final professional report and group presentation proposing their climate adaptation solution.

This process will emphasize integration of technical writing, research skills, stakeholder engagement, and systems thinking, while fostering climate adaptation competencies including futures thinking and adaptive planning.

Teaching and Learning Methods

The module uses a challenge-based, student-centred approach combining lectures, group work, and independent study. Key teaching methods include:

- Facilitated group work to supporting project development through workshops and collaborative tasks.
- Independent study of research topics, team collaboration, and assessment preparation.
- Peer learning and stakeholder engagement to encourage transdisciplinary knowledge sharing and interaction with professionals to enrich real-world understanding.

These methods are designed to foster interdisciplinary collaboration, applied research skills, and effective professional communication.

Assessment Details[34]

Assessment Component	Assessment Description	LO Addressed	% of total	Week due
Coursework	Group exercise - problem definition and planning strategy	LO1-4	10%	4
	Knowledge map of evidence in specific area of climate adaptation engineering	LO1-5	25%	8
	Group presentation on climate adaptation engineering solution	LO1-5	10%	11
	Group report (proposal) on proposed climate adaptation solution	LO1-5	50%	12

[34] TEP Guidelines on Workload and Assessment

	Self-reflection and peer evaluation	LO1-5	5%	12

Reassessment Requirements	Resubmission of failed coursework components.
Contact Hours and Indicative Student Workload[4]	**Contact hours:** 33 (11 hours of lectures, 22 hours of groupwork). **Independent Study (preparation for course and review of materials):** 44 hours. **Independent Study (preparation for assessment, incl. completion of assessment):** 48 hours.
Recommended Reading List	Suggested literature provided as part of embedded activities within the module.
Module Pre-requisite	
Module Co-requisite	
Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.	School of Engineering, Civil Structural and Environmental Engineering
Academic Start Year	

School Policies and Procedures

Health and Safety

Health

Please inform either the Programme Director of medical conditions or other problems that may require special attention from staff. In case of illness, students may attend the Student Health Centre (House 47).

Accidents

All accidents must be reported to the Safety Officer (Alison Boyce ext: 3506) as soon as possible after they occur. Victims should be escorted to the Student Health Centre for treatment if necessary. An ambulance should be called in the event of a serious accident (9-999 on phones with outside lines and inform the security office). Victims should not be taken to hospital in a private car or taxi.

Fire Safety

Fire extinguishers and copies of the College General Fire Notice are displayed at various locations in the campus. These are normally located in hallways. Fire extinguishers provided are water, powder, carbon dioxide or a fire blanket.

Help to prevent fires from starting or spreading by the following:

- Do not store flammable materials in corridors and other open-access areas.
- Exercise caution when using flammable materials and electrical equipment.
- Do not place smouldering items in bins
- Keep filing cabinets and presses closed when not in use
- Turn off and switch off at the socket (or unplug) electrical equipment that is not in use.

The college buildings are equipped with fire alarms. On hearing the alarm, leave the building quickly and in an orderly manner, and assemble at the designated meeting point for that building.

Bomb Alerts

Watch out for suspicious packages at all times and, if one is observed, alert a staff member immediately. If there is a bomb alert, follow the same procedures as for a fire alert.

Risk Assessment

A risk assessment must be carried out for research activities such as field work. Risk assessment forms are available from the Safety Officer and will also be available on Blackboard. Detailed safety guidelines on fieldwork are available from the department's Safety Officer and should be

consulted before fieldwork is undertaken. A risk assessment should be completed **BEFORE** conducting fieldwork.

IMPORTANT NOTE: Failure to complete the relevant forms may prevent you from undertaking fieldwork or participating in field trips, and can result in you forfeiting marks for associated.

Submission & Deadlines

Assignments must be submitted by the time and date stipulated by the module coordinator in the timetable; submission will be via Blackboard. Each assessment must include a completed title page template and a plagiarism declaration form.

It is your responsibility to ensure work is submitted on time. It will be date stamped in Blackboard. You should keep copies of all work that you submit. Assessments submitted after the deadline will receive a 10% deduction in the final mark for each working day late. Assessments will not be marked if more than two working days late unless by prior, written agreement with the module co-ordinator.

Marking and Award of MSc

The M.Sc. in Smart & Sustainable Cities will be awarded Pass or Pass with Distinction.

Pass with distinction shall require at least 70% in dissertation and at least 70% in the final aggregated mark.

Assessment of individual assignments will be based on common grading criteria as follows:

Grade	Mark (%)
A+	>75
A	70-74
B+	65-69
B	60-64
C+	55-59
C	50-54
FAIL	<50

Table 1: Indicative grades and associated provisional mark range for formative feedback. Marks are finalised at the Court of Examiners.

Unless otherwise stated, indicative grades will be circulated within **one month** of submission. All assessed work **MUST BE RETURNED** prior to the first Court of Examiners meeting. The deadline for return of work will be circulated during the semester.

Note: these grades are indicative. **All marks are provisional** until passed by the Court of Examiners meeting, which is held after the end of module teaching.

Attendance

All students should enter residence in or near Dublin and must begin attendance at the College not later than the first day of teaching term and may not go out of residence before the last day of teaching term unless **they have previously obtained permission from the Senior Lecturer through their tutor.**

Students must attend College during the teaching term. They must take part fully in the academic work of their class throughout the period of their course. Lecture timetables are published through my.tcd.ie, and on school or discipline noticeboards or in Blackboard before the beginning of Michaelmas teaching term. The onus lies on students to inform themselves of the dates, times and venues of their lectures and other forms of teaching by consulting these timetables. Please ensure you familiarise yourself with various time-tables, including the possibility of in-class exams during revision week, the normal exam period etc.

The requirements for attendance at lectures and tutorials vary between the different faculties, schools, and disciplines. The school, discipline, or course office, whichever is relevant, publishes its requirements for attendance at lectures and tutorials on noticeboards, and/or in handbooks and elsewhere, as appropriate.

Assessment: Procedures for the non-submission of coursework and absence from examinations

All students must fulfil the course requirements of the school or discipline, as appropriate, with regard to attendance and course work. Where specific requirements are not stated, students may be deemed non-satisfactory if they miss more than a third of their course of study or fail to submit a third of the required course work in any term.

Full regulations on non-submission of coursework can be found via the following:

https://www.tcd.ie/calendar/undergraduate-studies/general-regulations-and-information.pdf

(Specific Regulations by Course in STEM Faculty - Undergrad and postgrad) faculty-of-science-tech-eng-maths.pdf

At the end of the teaching term, students who have not satisfied the school or department requirements may be reported as non-satisfactory for that term. Students reported as non-satisfactory for the Michaelmas and Hilary terms of a given year may be refused permission to take their semester two assessment/examinations and may be required by the Senior Lecturer to repeat their year.

Further details of procedures for reporting a student as non-satisfactory are given on the College website at https://www.tcd.ie/academicregistry/student-cases/

Plagiarism

Plagiarism is interpreted by the University as the act of presenting the work of others as one's own, without acknowledgement. Plagiarism is considered as academically fraudulent, and an offence against University discipline. The University considers plagiarism to be a major offence, and subject to the disciplinary procedures of the University. Plagiarism can arise from deliberate actions, and also through careless thinking and/or methodology. The offence lies not in the attitude or intention of the perpetrator, but in the action and in its consequences. **It is your responsibility to familiarise yourself with the regulations regarding plagiarism. These are clearly outlined in Part 3 of the College Calendar. This can be downloaded from the College website: https://www.tcd.ie/teaching-learning/academic-policies/academic-integrity/**

Students are also asked to pay special attention to the rules on the use of Artificial Intelligence in preparing essays or similar submissions, particularly in reference to its ethical significance:

https://www.tcd.ie/academicpractice/assets/pdf/college-statement-on-genai.pdf

Depending upon the particular module, course coordinators will provide further guidance on the particularities of the use of AI.

GenAI

Aligned with the College Statement on Artificial Intelligence and Generative AI in Teaching, Learning, Assessment & Research (2024), the use of GenAI is permitted unless otherwise stated.

Where the output of GenAI is used to inform a student's document or work output, this usage

should be acknowledged and appropriately cited, as per Library guidelines on acknowledging and referencing GenAI. From an academic integrity perspective, if a student generates content from a GenAI tool and submits it as his/her/their own work, it is considered plagiarism, which is defined as academic misconduct in accordance with College Academic Integrity Policy.

Progression rules

Students are assessed for each taken module with a grade/numerical percentage mark (%) at the end of the semester/term during which delivery of a module is completed. All end-of-module marks will be distributed by the module coordinators directly to the students (normally via Blackboard). The Pass mark for a module is 50% of the total marks available for the module.

The final overall mark is based on a credit-weighted average of the mark awarded in each module. A Pass mark on this course is 50% and above. Students must obtain credit for academic year of their course by satisfactory completion of all course requirements. To qualify for the relevant postgraduate award, students must, as a minimum:

a) achieve an overall pass mark which is normally the credit-weighted average mark for all taught modules taken;

b) achieve a pass mark in all modules designated as non-compensable, and;

c) achieve a pass mark in the research element or dissertation. Module marks are considered by the court of examiners at the end of year and results will be passed on to the Academic Registry and inputted to SITS.

Students may compensate for one fail mark so long as the average of all taught components is over 50% and the failed module result is between 40 and 49%. The Placement Module and the Fieldtrip Modules are non-compensable. Final results are determined at the final Court of Examiners' meeting at the end of the academic year with the external examiner input. Students failing to pass individual taught modules may present for supplemental examination or re-submit required work. Students who, following the supplemental examination or re-assessment, have failed to pass the requisite taught modules will be deemed to have failed the course, and may apply to the School for permission to repeat it. Students who do not achieve a pass mark in the research element or dissertation will be deemed to have failed the course and may apply to the School for permission to repeat it. Alternatively, such students may be awarded an associated Postgraduate Diploma.

In order to qualify for the award of Masters with Distinction students must as a minimum (i) pass all taught modules and (ii) achieve a final overall average mark (taught modules and dissertation) for the course of at least 70% and iii) achieve a mark of at least 70% in the dissertation. A distinction cannot be awarded if a candidate has failed any taught module. Compensated modules are considered to be passed in this case. Students who do not pass the taught modules (either outright or by compensation) will be deemed to have failed overall and may apply to repeat the course.

P.Grad.Dip (exit award) A student who does not wish to submit a research project and be considered for the degree of MSc may instead opt to be considered for a Postgraduate Diploma by applying to the Course Coordinator in writing before the end of April. Where a student achieves a pass, outright or by compensation, in the 60 ECTS of taught modules and has an overall average mark of at least 50% for the taught component but does not reach the required standard in the research project, she or he may be eligible for the award of a Postgraduate Diploma.

To qualify for the award of the P.Grad.Dip, students must pass 60 ECTS of taught modules. Such students may compensate for 20 ECTS (between 40% and 49% only) as long as the overall credit weighted mark across 60 ECTS of taught modules is 50% or over and students have passed outright modules amounting to at least 40 credits.

The Postgraduate Diploma may be awarded Distinction to candidates who, in addition, achieve an overall average mark of at least 70% across the 60 ECTS modules. In order to qualify for the award of Postgraduate Diploma with Distinction students must as a minimum (i) pass all taught modules and (ii) achieve a final overall average mark (taught modules) of at least 70%. A Postgraduate Diploma with Distinction cannot be awarded if a candidate has failed any taught module. Modules that are compensated are considered as passed in this situation.

An exit award of Postgraduate Diploma in Smart & Sustainable Cities will be considered. The graduand who has been awarded the Postgraduate Diploma is not eligible to re-register on the course in the future for the award of the MSc degree.

All postgraduate examination results are published anonymously under a student's registered number. Students who successfully complete their programme will have the qualification, where appropriate, awarded under their registered name and within grade. Students are entitled to supplement any failed module, except the dissertation which cannot be repeated, once.

The maximum grade which can be awarded to a supplemental assignment/exam is 50%.

Graduation (conferring)

The Academic Registry will contact students directly with full information regarding graduation. Students will have to confirm attendance or it they are graduation in absentia. Graduations will take place during the Winter Ceremonies. More information here: Graduation - Academic Registry - Trinity College Dublin

Appeals, re-marking of assessments, and disciplinary redress process

Complaints procedure in relation to modules

If there are issues/concerns in relation to a particular module this should first be brought to the attention of the module coordinator by the class representatives. In the event that this is not resolved at this level to the satisfaction of the class the class representatives should then contact the director of the programme. This protocol also applies to requests for additional feedback on assignments or second readers for these by individual students.

Review procedure in relation to module grades

If there are issues/concerns in relation to the grading of assignments, or a request for more feedback, this should first be brought by the student to the attention of the module coordinator in question. In the event that this is not resolved at this level to the satisfaction of the student they should then contact the director of the programme. The student may request a second marker for the assignment in question.

Requests for feedback and/or second marking must be lodged within one week of receipt of module marks. Students must always bring their request pertaining to any module taught on the course to the module coordinator in the first instance.

In the case of an appeal whose nature goes beyond module-related issues, and unless otherwise recommended by the course committee, the appeal will follow the appeal procedure for taught postgraduate courses.

The appeal procedure to be followed is that laid down in relevant paragraphs of the Appeals process for Graduate Students in the "University of Dublin, Trinity College Calendar Part 3, Graduate Studies and Higher Degrees" for a given academic year.

https://www.tcd.ie/calendar/graduate-studies-higher-degrees/

**** N.B. Appeals must be lodged within 30 days of the result of the assessment being made available to you.**

The regulations for re-checking/re-marking and retention of examination scripts and assignments to be followed are described in relevant paragraphs of the *Regulations for re-checking/re-marking and retention of examination scripts* in the "*University of Dublin, Trinity College Calendar Part 3, Graduate Studies and Higher Degrees"* for a given academic year.

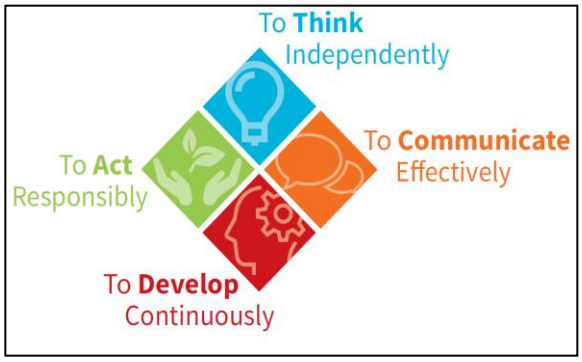
At all stages of the appeal and/or re-checking/re-marking processes consultation with the Course Director about the implications of offence and penalty is necessary. The same applies to fitness to practice issues, where relevant, and performance at the fieldwork training.

Graduate Attributes

The Trinity Graduate Attributes represent the qualities, skills, and behaviours that you will have the opportunity to develop as a Trinity student over your entire university experience, in other words, not only in the classroom, but also through engagement in co- and extra-curricular activities (such as summer work placements, internships, or volunteering).

The four Trinity Graduate Attributes are:

- To Think Independently
- To Act Responsibly
- To Develop Continuously
- To Communicate Effectively



Why are the Graduate Attributes important?

The Trinity Graduate Attributes will enhance your personal, professional, and intellectual development. They will also help to prepare you for lifelong learning and for the challenges of living and working in an increasingly complex and changing world.

The Graduate Attributes will enhance your employability. Whilst your degree remains fundamental, also being able to demonstrate these Graduate Attributes will help you to differentiate yourself as they encapsulate the kinds of transversal skills and abilities, which employers are looking for.

How will I develop these Graduate Attributes?

Many of the Graduate Attributes are 'slow learned', in other words, you will develop them over the four or five years of your programme of study.

They are embedded in the curriculum and in assessments, for example, through undertaking independent research for your final year project, giving presentations and engaging in group work.

You will also develop them through the co-curricular and extra-curricular activities. If you help to run a club or society you will be improving your leadership skills, or if you play a sport you are building your communication and team-work skills.

Important Information

Student Services

For general information on the Supports and Services available to Trinity Students please visit: https://www.tcd.ie/students/supports-services/

This is a comprehensive site which breaks down the different categories of support and services available to students is an intuitive manner.

Follow on to the next page for a breakdown of some of our key supports and services.

Postgraduate Advisory Service

The Postgraduate Advisory Service was established in 2009 to extend Trinity's historic and unique tutorial service to the postgraduate community. We offer free, independent, and confidential support, guidance and advocacy to registered postgraduate students at Trinity.

When should I contact them?

Postgraduate Advisory Service (PAS) provides support on any matter that may impact upon your time as a postgraduate at Trinity. Some of the most common issues students come to PAS to discuss include: study-related stress or worry; concerns about academic progress; supervisor-relationship concerns; extensions and going off-books; queries regarding regulations and academic appeals; bullying; plagiarism and disciplinary cases.

What Supports do they provide to students?

They provide frontline confidential and free support, information, and referral via the Postgraduate Student Support Officer;

On referral, named academics provide advice, advocacy, and assistance via the panel of Postgraduate Advisors;

A suite of complementary supports is available including informal mediation, workshops and training to postgraduates;

Administering the Postgraduate Student Assistance Fund and other financial assistance to postgraduate students.

How do I get in touch?

For general or brief queries, you can email PAS at postgrad.support@tcd.ie. Please be sure to include your name, School/ course and a brief outline of your query/concern.

To make an appointment with the Postgraduate Student Support Officer, email PAS postgrad.support@tcd.ie, with your name, student number, School/ course and a brief outline of your query/concern.

For full details about PAS, on making a query or requesting an appointment visit: https://www.tcd.ie/seniortutor/students/postgraduate/

Careers Advisory Service

What do you want to do? How will you get there? We are here to support you in answering these and other questions about your career.

Junior and Senior Fresh Students

Get Involved: Remember that your course of study, extra- curricular activities, voluntary and part-time work all provide opportunities for developing skills and gaining an insight into your career preferences. In your Senior Fresh year, look out for short-term internship opportunities.
MyCareer: Log in to MyCareer to keep abreast of jobs, study and careers events of interest to you.

Junior Sophisters

Attend class seminar: Typically this takes place in Hilary term and includes information on applying for work experience and internships and postgraduate study.
Get work experience: The programme of summer work experience and internships is particularly relevant to Junior Sophisters. Personalise your MyCareer profile to receive email alerts tailored to your preferences.
MyCareer: Log in to MyCareer to keep abreast of jobs, study and careers events of interest to you.

Finalists and Senior Sophisters

Meet Employers and/or Explore Further Study: You may have decided to seek employment directly after graduation and many employers visit Dublin to actively seek out talented graduates. For others, further study may be their preferred option. Your MyCareer dashboard will keep you informed.
Find Jobs: Personalise your MyCareer profile to receive email alerts tailored to your interests.
Attend class seminar: Typically this takes place in Michaelmas term and includes information on applying for postgraduate study and jobs.
GradLink Mentoring: An opportunity to get advice and support from a Trinity graduate.
Drop-In CV/ LinkedIn Clinics: We also provide support at a practical level, helping you to improve your applications, which will benefit you in securing your future, whether in employment or further study.
Practice Interviews: A practice interview tailored to the job/ course of your choice with practical feedback.
MyCareer: Log in to MyCareer to keep abreast of jobs, study and careers events of interest to you.

MyCareer

An online service that you can use to:

- Apply for opportunities which match your preferences - vacancies including research options
- Search opportunities- postgraduate courses and funding
- View and book onto employer and CAS events
- Submit your career queries to the CAS team

- Book an appointment with your Careers Consultant

Simply login to MyCareer using your Trinity username and password and personalise your profile.

Careers Advisory Service
Trinity College Dublin, 7-9 South Leinster Street, Dublin 2
01 896 1705/1721 | Submit a career query through MyCareer

MyCareer: mycareerconnect.tcd.ie
TCD.Careers.Service
TCDCareers
www.tcd.ie/Careers/students/postgraduat
@TCDCareers
tinyurl.com/LinkedIn-TCD-Connecting

Opening Hours: Term: 9.30am - 5.00pm, Monday – Friday **Out of Term:** 9.30am - 12.30pm & 2.15 - 5.00pm, Monday - Friday

Disability Services

The Disability Service aims to provide appropriate advice, support and information to help students and staff with disabilities. The Disability Service has in place a range of supports to ensure that students with disabilities have full access to the same facilities for study and recreation as their peers. Most students registering with the Disability Service request access to a range of supports that help the student reach their full potential while studying. Most students' needs are accommodated through these supports. The student decides what level of support they require.

For contact information or to make an appointment please contact the Disability Services – contact details are available via the following webpage:
https://www.tcd.ie/disability/contact/

Student Learning Development

Student Learning Development offers support in a variety of study and learning skills including essay writing, exam preparation, study skills, self and time-management and note taking. Mechanisms of support are workshops, individual appointments and drop-in clinics.
For new students: https://www.tcd.ie/sld/your-student-journey/new-to-trinity/
For Undergraduate Students: https://www.tcd.ie/sld/your-student-journey/undergraduate-students/
For Postgraduate Students: https://www.tcd.ie/sld/your-student-journey/postgraduate-students/
For general information on all resources and supports available visit: https://www.tcd.ie/sld/

Student Health and Wellbeing

College Health Service

Trinity Health Services have GP services available for the following Opening Hours: Please contact us on 01 8961556 or 01 8961591 between 9am and 1pm and from 2-4:30pm

You can email collegehealth@tcd.ie , but please note that this email is NOT FOR ANY MEDICAL/CLINICAL enquiries and is not manned to manage clinical/medical enquiries, strictly only admin.

The Physiotherapist operates daily between 09.00 and 13.00 and also Monday/Tuesday afternoons during term time.

For further information visit: https://www.tcd.ie/collegehealth/

Student Counselling

The Student Counselling Service is here to help you to manage any difficulties you are experiencing so you can enjoy and fully participate in your time here at College.

If you wish to make an appointment with the Student Counselling Service, please consider one of the options below. If you have any other queries you can call into reception on the 3rd floor of 7-9 South Leinster Street or contact us on:
Phone: (01) 896 1407
Email: student-counselling@tcd.ie
For further information visit the following webpage: https://www.tcd.ie/StudentCounselling/

Student Life

Student life offers information on Supports and Services, Clubs and Societies, Student Unions etc., https://www.tcd.ie/students/

Academic Registry

The Academic Registry is responsible for services that support the complete student lifecycle of Trinity College Dublin – from application to graduation.

For information on Registration, Fees, Grants, ID Cards etc. visit the Academic Registry (AR). AR is located in in the Watts Building, on the first floor, or visit the AR website: https://www.tcd.ie/academicregistry/
Queries can be emailed to academic.registry@tcd.ie, or you can telephone 01 896 4500 during office hours.

Student Accommodation

CAMPUS: The Accommodation Office is open Monday to Friday from 8.30am to 1pm and 2pm-5pm each day. Queries can be emailed to residences@tcd.ie, or you can telephone 01 896 1177 during office hours.

After hours you can contact Front Gate at 01 896 3978 in case of difficulties or key problems. In Goldsmith Hall attendants are on duty in the residential area at weekends and overnight and they will assist with local problems.

In the event of a serious emergency, particularly where you require the attendance of ambulance, fire or police services please telephone College Security at 01 896 1999 (internal 1999). To ensure a co-ordinated response please do not call these services directly. We recommend that you programme these numbers into your mobile phone using the prefix "01" before the number. https://www.tcd.ie/accommodation/

Appendix 1

Item	Reference/Source
Statement on General Regulations	Calendar, Part II, General Regulations and Information, Section II, Item 12 Calendar, Part III, GeneralRegulations, Section I
Student Supports Co-curricular activities TCDSU, GSU & student representationstructures	Student Supports
Emergency Procedures	In the event of anemergency, **dial Security Serviceson extension 1999** Security Services provide a 24-hourservice to the college community, 365 days a year. They are the liaison to the Fire, Garda and Ambulance services and all staff and students are advised to alwaystelephone extension 1999 (+353 1 896 1999) in case of an emergency. Should you require any emergencyor rescue services on campus, you must contact Security Services. This includes chemical spills,personal injury or first aid assistance. It is recommended that all students save at least one emergency contact in their phone under ICE (In Case of Emergency).
Data Protection	Data Protection for StudentData
Research Ethics	Policy on Good ResearchPractice

Item	Reference/Source
Plagiarism &Referencing Guidance	Calendar, Part B, General Regulations and Information Calendar, Part III, General Regulations & Information, Section I 'Plagiarism' Plagiarism Policy
Health and Safety Statements	Faculty of Science Engineering, Mathematics and Science website - https://www.tcd.ie/stem/undergraduate/health-safety.php
Absence fromExaminations	Calendar, Part B, General Regulations and Information Calendar, Part III, Section III,'Examinations, Assessment and Progression' Academic Policies
Reference to Relevant University Regulations	Academic Policies Student ComplaintsProcedure Dignity and Respect Policy - Equality, Diversity and Inclusion | Trinity College Dublin (tcd.ie)
Timetable for students	My TCD
Internships/ Placements forCredit	Internship and PlacementPolicy.
Item	**Reference/Source**
Marking Scale	Calendar, Part B, General Regulations and Information
Progression Regulations	Calendar, Part II, General Regulations & Information Calendar, Part II, Part C Calendar, Part III, Section III 'Examinations, Assessment and Progression' and 'Assessment and Progression Regulations'
Awards	National Framework forQualifications Trinity PathwaysTrinity Courses

Professional and Statutory Body Accreditation	Provided by School/Discipline Handbooks where applicable
Careers Information &events	https://www.tcd.ie/Science/careers/
External Examiner	Procedure for the transfer ofstudents assessed work to external examiners
Attendance Requirements	Calendar, Part B, General Regulations and Information Calendar, Part III, General Regulations and Information, Section I 'Attendance and Off-Books'; Section II 'Attendance'; Section III 'Attendance, Registration, Extensions'; Section IV 'Attendance and Examinations'
Feedback andEvaluation	Student Evaluation andFeedback Student Partnership Policy Procedure for the conduct ofFocus Groups