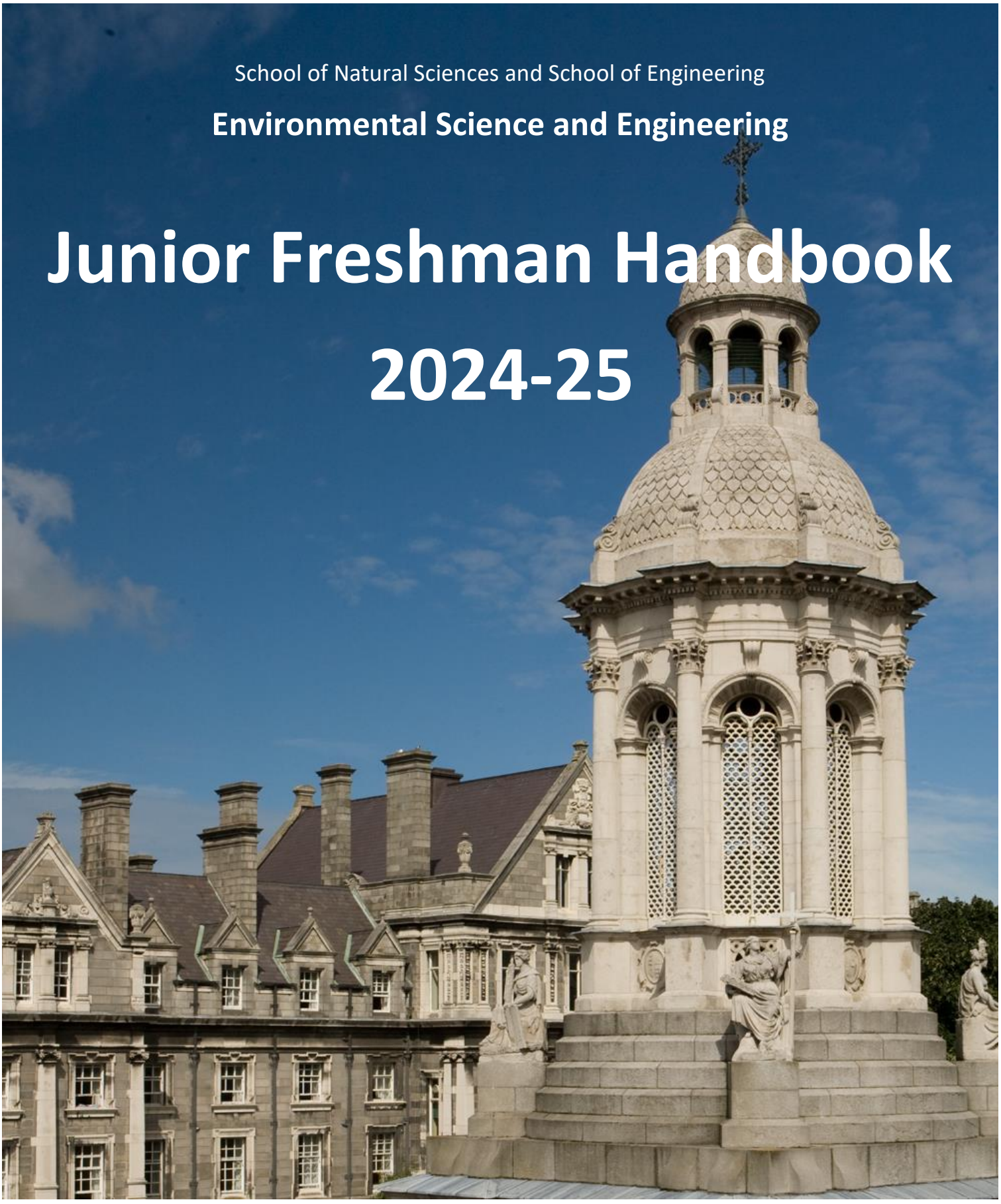
Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

School of Natural Sciences and School of Engineering

Environmental Science and Engineering

Junior Freshman Handbook

2024-25



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Statement on General Regulations

All students are encouraged to fully familiarise themselves with colleges rules and general regulations which can be found here:

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

Your attention is drawn to the University Calendar Part II (the relevant parts of which are available at registration, or from your tutor) and, in particular, sections that outline general rules governing all student's progression and attendance through College. The information provided in this handbook is accurate at the time of preparation. Any necessary revisions will be notified to students via email. In the event of any conflict or inconsistency between the General Regulations published in the University Calendar and information contained in course/departmental handbooks, the provisions of the General Regulations will prevail.

Welcome

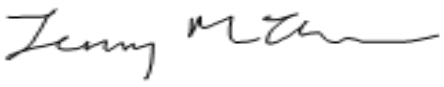
You are very welcome to the TCD Schools of Engineering and Natural Sciences on this new flagship course for the university, TR064 Environmental Science and Engineering. Environmental Engineers and Applied Environmental Scientists who graduate from this interdisciplinary programme will be uniquely positioned to address some of the most challenging and important questions of our time in terms of sustainable development, particularly with respect to the protection of the environment. With the mounting global challenges of climate change, biodiversity loss, water resources depletion and contamination, urbanization and agricultural intensification driven by the demands of a growing global population, increasing numbers of Environmental Engineers and Applied Environmental Scientists are needed with the requisite knowledge and skills to tackle such challenges. These challenges have been succinctly captured within the United Nations Sustainable Development Goals.

All students follow a common programme for the first two 'fresh' years followed by two 'sophister' years of increasing specialisation in either Applied Environmental Science or Environmental Engineering. Admission to the Master's level is subject to performance in the Junior Sophister and Senior Sophister years. While there is a strong focus on scientific and technical content and problem solving in the syllabus, personal skills such as communication and teamwork are an integral part of your education. These skills are crucial in promoting an approach to lifelong learning, particularly important in today's dynamic world. The curriculum is revised on an ongoing basis and we hope that you will find it stimulating and intellectually rewarding. You will be given the opportunity to provide us with considered feedback of your experience during each year of your studies.

The College has a great deal to offer besides the formal academic programme, including the cultural, recreational and sporting activities of the many student clubs and societies. You are strongly encouraged to participate in the breadth of College life in a balanced way. There are opportunities to study abroad in Year 3 of this course and your first year grades will be used to rank your application so we encourage to to start exploring ERASMUS, UNITECH and international study options and plan early.

Finally, be aware that College offers a wide range of support services. If you are experiencing problems or need to seek advice (personal, financial, health, career or academic), there are a number of sources of help available: these are listed in Section X of this booklet. Do not hesitate to call on these services should the need arise. Each of you has been allocated a tutor, and he/she is an excellent resource to help you with identifying relevant support services. We wish you a successful and enjoyable first year at University.

Professor Jennifer McElwain



School of Natural Sciences

Professor Laurence Gill

School of Engineering

Course Objectives and Learning Outcomes

Environmental Science and Engineering is an integrated undergraduate with postgraduate degree course that aims to train the next generation of graduates who have the competencies, knowledge and experience necessary to design and deploy solutions that protect and improve our environment and human wellbeing, and that work with rather than against the natural world to foster biodiversity, climate action and sustainable use of earth's finite resources. The course will provide students with fundamental grounding in the Natural Sciences and Engineering, and in the applied skills required to develop sustainable solutions for major societal and environmental challenges. The unique combination of Engineering and Natural Sciences modules represents one of the first in Ireland and internationally. Strong emphasis is placed on students acquiring practical laboratory and field skills as well as working in teams.

Learning outcomes:

On completion of the *single honours integrated programme* in **Environmental Engineering** students should be able to:

LO1: Demonstrate knowledge and understanding of the mathematics, sciences, engineering sciences and technologies underpinning environmental system;

LO2: Demonstrate an interdisciplinary knowledge and appreciation of the importance and finite nature of Earth's resources and natural capital;

LO3: Demonstrate deep knowledge and understanding of local to global environmental challenges facing society;

LO4: Work effectively as an individual, in teams and in multi-disciplinary settings, together with the capacity to undertake lifelong learning;

LO5: Communicate effectively on engineering activities with the engineering community and with society at large;

LO6: Identify, formulate, analyse and solve engineering problem;

LO7: Perform the detailed design of a novel system, component or process using the analysis and interpretation of relevant data;

LO8: Design and conduct experiments and to apply a range of standard research tools and techniques of enquiry; and

LO9: Display high ethical standards in the practice of engineering, including the responsibilities of the engineering profession towards people and the environment.

On completion of *year 5 of the integrated Environmental Science and Engineering programme*, **Environmental Engineering** students should be able to meet the following Course Leaning Outcomes:

CLO1. Demonstrate advanced knowledge of the mathematics, sciences, engineering sciences and technologies underpinning Environmental engineering.

CLO2. Identify, formulate, analyse and solve complex engineering problems.

CLO3. Perform independently a detailed design of a novel system, component or process by analysing and interpreting relevant data.

CLO4. Design and conduct experiments and to apply a range of standard and specialised research (or equivalent) tools and techniques of enquiry.

CLO5: Display high ethical standards in the practice of engineering, including the responsibilities of the engineering profession towards people and the environment as well as demonstrating a wide perception of societal needs and dynamics.

CLO6: Work effectively as an individual, in teams and in multi-disciplinary settings.

CLO7: Communicate effectively on complex engineering activities with the engineering and environmental science community and with society at large.

CLO8. Engage in lifelong professional development

CLO9. Demonstrate advanced knowledge of specialized areas within environmental engineering.

On completion of the *single honours integrated programme* in **Applied Environmental Science,** students should be able to:

LO1. Demonstrate knowledge and understanding of the mathematics, sciences, engineering sciences and technologies underpinning environmental systems;

LO2.Demonstrate an interdisciplinary knowledge and appreciation of the importance and finite nature of Earth's resources and natural capital;

LO3.Demonstrate deep knowledge and understanding of local to global environmental challenges facing society;

LO4.Work effectively as an individual, in teams and in multi-disciplinary settings, together with the capacity to undertake lifelong learning;

LO5.Communicate effectively on environmental science activities with the environmental science(and engineering)community and with society at large;

LO6.Display advanced knowledge and skill in design, experimentation, data analysis and interpretation to develop and implement real-world solutions for local to global environmental issue;

LO7.Show a deep appreciation of the ethical, political and human rights principles underpinning sustainable development; and

LO8.Demonstrate strong theoretical and technical competence in Environmental Science.

On completion of *year 5 of the integrated Environmental Science and Engineering programme*, **Applied Environmental Science** students should be able to:

CLO1. Demonstrate advanced knowledge and understanding of local to global environmental challenges facing society.

CLO2. Demonstrate advanced interdisciplinary knowledge and appreciation of the importance and finite nature of Earth's resources and natural capital.

CLO3. Make informed and ethical decisions that balance technical, social and environmental considerations.

CLO4. Work effectively as an individual, in teams and in multi-disciplinary settings.

CLO5. Communicate effectively on environmental science activities with the environmental science and environmental engineering community and with society at large.

CLO6. Use advanced knowledge and skill in design, experimentation, data analysis and interpretation to develop and implement real-world solutions for local to global environmental issues and challenges.

CLO7. Demonstrate advanced theoretical and technical competence in Environmental Science through an independent research project.

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 credit represents 20-25 hours estimated student input, so a 10-credit module will be designed to require 200-250 hours of student input including class contact time, assessments and examinations.

ECTS credits are awarded to a student only upon successful completion of the course year . Progression from one year to the next is determined by the course regulations. Students who fail a year of their course will not obtain credit for that year even if they have passed certain component courses. Exceptions to this rule are one-year and part-year visiting students, who are awarded credit for individual modules successfully completed.

Modules and Module Descriptors

Semester 1	Semester 2
ESU11001: Team Design – Global Environmental Challenges (5 Credits)	CEU11E09: Engineering Design 1: Graphics and CAE (5 Credits)
MAU11E01: Engineering Mathematics (5 Credits)	CEU11E13: Biology for Environmental Engineering (5 Credits)
MEU11E08: Introduction to Professional Engineering (5 Credits)	MAU11E02: Engineering Mathematics (5 Credits)
CHU11E05: Chemistry for Engineers (5 Credits)	PYU11E04: Physics (5 Credits)
GSU11004: Spaceship Earth: An introduction to Earth System Science (10 Credits)	GSU11005: Introduction to Geology: A beginners guide to Planet Earth (10 Credits)

Modules and Module Descriptions

Module Code: **ESU11001**

Module Name: **Team Design – Global Environmental Challenges**

ECTS: **5 ECTS**

Semester Taught: **Semester 1**

Module Coordinator/s: Prof. Jennifer McElwain (jmcelwai@tcd.ie)

Prof. Laurence Gill (laurence.gill@tcd.ie)

Module Content:

Team Design will introduce students to big picture global environmental challenges facing society through their own team-based research under the mentorship of a Professor in Environmental Science or Environmental Engineering. The concepts of sustainable development, Natural Capital and Trinity's role through research and education will also be communicated through tutorial discussions. Students will conduct a desk study in small teams on an environmental topic of their choice in weekly tutorials culminating in a 5000 word group report and 15 minute group presentation to student peers and tutorial supervisors. Through weekly tutorials students will learn how to source, analyse and appraise published scientific and engineering literature on the environmental topic of their choice. Tutors will guide students through the research process covering plagiarism, research ethics, citations and appropriate attribution, critical thinking, independent research, team work, project planning and how to draw project conclusions and communicate them to an audience of their peers

Learning Outcomes:

1. Discuss broadly Trinity's E3 initiative, the UN Sustainability Goals, the concepts of Natural Capital, Environmental Engineering and Environmental Sciences

2. Explain key global environmental challenges

3. Engage with the processes and practices involved in independent desk research on an environmental topic of global importance

4. Work as part of a team

5. Self-reflect on learning and Knowledge acquisition through a learning journal

6. Communicate effectively to peers

7. Use analytical and discursive skills

Recommended Reading:

https://www.ipcc.ch/

https://sustainabledevelopment.un.org/?menu=1300

https://www.tcd.ie/e3/

Peer reviewed literature on student chosen topic Blackboard resources

Module Code: **MAU11E01**

Module Name: **Engineering Mathematics I**

ECTS: **5 ECTS**

Semester Taught: **Semester 1**

Module Lecturer: **Prof. Patrick Fritzsch (fritzscp@tcd.ie)**

Module Content:

Engineering Mathematics I is a half-year module taken by all Junior Freshman Engineering, Engineering with Management and Environmental Science and Engineering students. It starts with the calculus of functions of one real variable, formalising and building on Leaving Certificate mathematics. The module emphasises both theoretical foundations of calculus and application of mathematical methods and is intended to enable students to recognise mathematical structures in practical problems, to translate problems into mathematical language and to apply differentiation and integration to solve them.

Functions: definition, domain and range, operations with functions, inverse function, graphs, notions of rational, algebraic, and trigonometric functions;

Limits and Continuity: Two-sided, one-sided, and infinite limits, limit at infinity and asymptotes; continuity, delta-epsilon language, intermediate-value and squeezing theorems;

Differentiation of functions of one variable: the derivative function, techniques of differentiation, implicit differentiation, related rates problems and the local linear approximation;

Derivatives in graphing and applications: Analysis of functions, graphing polynomials and rational functions, applied maximum and minimum problems and the Newton-Raphson method;

Integration: antiderivatives and introduction to integration, Riemann Sums, integration by substitution and the Fundamental Theorem of Calculus;

Applications of the Definite Integral in Geometry: area between curves, volumes and areas of solids of revolution and length of a plane curve.

Learning Outcomes:

Recognise mathematical structures in practical problems, translate problems into mathematical language, and analyse problems using methods from one-dimensional calculus;

Solve problems involving concepts of calculus;

Apply differentiation to solve practical problems and to graph a wide range of functions of one real variable;

Apply integration to solve geometrical problems such as computing the area or volume of solids of revolution;

Use standard computer input for mathematical expressions.

Recommended Reading:

Calculus: Late Transcendentals - Howard Anton, Irl Bivens, Stephen Davis.

Calculus – An Intuitive and Physical Approach". Morris Kline.

Calulus – M.Spivak

Mathematics Its Content, Methods, and Meaning – M.A. Lavrentev, A.D. Aleksandrov, A.N.Kolmogorov

Module Code: **MEU11E08**

Module Name: **Introduction to Professional Engineering**

ECTS: **5 ECTS**

Semester Taught: **Semester 1**

Module Coordinator/s: Assistant Professor Muhammad Ali (Muhammad.ali@tcd.ie)

Associate Professor Kevin O' Kelly (Kevin.OKelly@tcd.ie)

Professor Khurshid Ahmad (khurshid.ahmad@scss.tcd.ie)

Assistant Prof. Enda Bates (ebates@tcd.ie

Module Content:

The module involves 24 lectures, 6 each from: Civil, Structural and Environmental Engineering; Mechanical and Manufacturing Engineering; Computer Science and; Electronic and Electrical Engineering over the first six weeks. This is followed by 20 hours of structured tutorials focused on project work.

Introduction to engineering

Environmental issues in engineering

Engineering ethics

Engineering forensics

Physical and cyber sustainability

Group interaction and team collaboration

Design processes and outcomes

Survey design and trend identification

Report writing

Learning Outcomes:

1. Contextualise the wider role of the professional engineer in society;

2. Articulate the ethical, economic, social, regulatory and political issues that also arise in the context of a technical project;

3. Organise a team project by defining team roles and planning a set of tasks and actions;

4. Explain the different roles involved in the management of a team project as well as checking progress and monitoring results;

5. Self-structure a work programme around a set of open ended questions;

6. Apply structured design processes to achieve design outcomes

7. Provide evidence for ideas, concepts and suggestions;

8. Communicate effectively in written and verbal formats.

Module Code: **CHU11E05**

Module Name: **Chemistry for Engineers**

ECTS: **5 ECTS**

Semester Taught: **Semester 1**

Module Coordinator/s: Assist. Professor Richard Hobbs (hobbsr@tcd.ie)

Module Content:

Introduction and General Chemistry

• Chemical change; elements, compounds and mixtures; atomic theory; stoichiometry and chemical equations; atomic structure; electronic structure and the periodic table; bonding; elementary structural chemistry; metals, semiconductors and insulators.

Physical Chemistry I

• Thermodynamics: First law, internal energy, enthalpy; introduction to entropy, 2nd and 3rd Laws; criterion for chemical change; equilibrium constant for a chemical reaction, Gibbs free energy.

Physical Chemistry II

• States of matter: Gibbs phase rule, ideal solutions, colligative properties

• Chemical Equilibrium: Law of mass action; factors that influence the position of equilibrium. Ionic equilibria: ionic equilibria in aqueous solutions; strong and weak acids and bases; buffer solutions and indicators;

• Electrochemistry; molar conductivity and electrolyte solutions; electrode potentials; cells; electrolysis; emf and chemical equilibrium; and introduction to analytical chemistry;

• Chemical Kinetics: rates of reactions; order and molecularity; activation energy; kinetics and mechanisms; catalysis

Learning Outcomes:

1. Explain chemical equations, balance them, and make calculations based on them relating to stoichiometry and molarity;

2. Relate trends in the periodic table (in both elements and their compounds) with the underlying trends in electronic and atomic structure;

3. Perform calculations on the rates of reaction and to relate reaction kinetics to the details of the reaction mechanism.

4. Perform calculations on chemical equilibria of different nature (acid-base, complexation, gas reactions, solubility, etc.);

5. Read and interpret basic phase diagrams of pure substances and binary mixtures;

6. Explain the properties of ideal and near-ideal solutions and carry out calculations using colligative properties;

7. Perform calculations of electrochemical potentials and relate them to thermodynamic quantities

8. Explain chemical reactivity (thermodynamic and kinetic) in terms of valency, electronegativity and electronic structure;

9. Relate some of the macroscopic properties of materials to the nature of the electronic structure and bonding at the molecular/atomic level;

10.Relate some of the macroscopic properties of materials to the nature of the electronic structure and bonding at the molecular/atomic level

Recommended Reading:

Chemistry –The Molecular Nature of Matter and Change, Silberberg, 6th edition, McGraw-Hill

Chemistry: Molecules, Matter and Change, P Atkins and L Jones, 4th edition*,*

Freeman Chemistry for Engineering Students, Brown and Holme, 1st edition, Thompson

Module Code: **GSU11004**

Module Name: **Spaceship Earth: An Introduction to Earth System Science**

ECTS: **10 ECTS**

Semester Taught: **Semester 1**

Module Coordinator/s: Dr Robin Edwards (robin.edwards@tcd.ie)

Module Content:

More than 7 billion people now inhabit the Earth and no corner of the planet is unaffected by human activity. The rise of our species has been fuelled by our ability to access planetary storehouses of energy and employ this to manipulate the environments around us. The global-scale of human impacts has led some to suggest we are entering a new era of Earth history - the Anthropocene. Dealing with the effects of environmental and climate change is one of the most significant challenge that our species faces in the 21st century.

This module provides a foundation for understanding global environmental issues by considering the Earth as an interconnected system in which matter and energy are exchanged between the Geosphere, Biosphere, Atmosphere, Hydrosphere and the Anthroposphere. It considers the life-support systems of 'spaceship Earth' and aims to provide a theoretical basis for evaluating the role of humans as agents of climate and environmental change.

Learning Outcomes:

1: Outline the fundamental concepts of Earth Systems Science with reference to its major subsystems: Geosphere, Biosphere, Atmosphere, Hydrosphere and Anthroposphere

2: Illustrate how material and energy are cycled through the Earth system

3: Describe the links between biotic and abiotic systems and their role in maintaining a habitable planet

4: Apply an Earth Systems approach to describe the phenomena of environmental and climate change

5: Discriminate between 'weather' and 'climate' and situate concerns about current climate change in a longer-term (geological) context

6: Identify how human activities modify Earth System function

7: Make links between Earth Systems Science and topics covered in their chosen field of study

Module Code: **CEU11E09**

Module Name: **Engineering Design I: Graphics and CAE**

ECTS: **5 ECTS**

Semester Taught: **Semester 2**

Teaching Staff: **Dr. John Hickey (john.hickey@tcd.ie)**

Module Content:

This module aims to introduce students to the basic concepts of engineering drawing. It is envisaged that upon completion of the module students should be able to both produce and interpret engineering drawings to a standard used in professional practice. While Drawings are a key part of the work of many engineers' work, this is a part of engineering practice that has changed fundamentally in recent decades with the widespread availability of computers and CAD packages. In light of this, the module aims to teach students the basics rules of engineering drawing, how to effectively produce quick sketches by hand and how to produce detailed drawings using CAD software.

Students complete a series of workbooks, which introduce key concepts and place a strong emphasis on hand sketching. Students are then taught to produce formal engineering drawings using industry-standard CAD packages.

Learning Outcomes:

LO1. Produce two-dimensional images of three-dimensional objects using hand drawn projections

LO2. Communicate design ideas via hand sketches

LO3. Produce two-dimensional images of three-dimensional objects using CAD software

LO4. Interpret and extract information from two-dimensional representations of three-dimensional objects

Recommended Reading:

Slade, Ron. Sketching for Engineers and Architects. Routledge, 2016

Module Code: **CEU11E13**

Module Name: **Biology for Environmental Engineering**

ECTS: **5 ECTS**

Semester Taught: **Semester 2**

Module Coordinator/s: Muhammad Ali (Muhammad.ali@tcd.ie)

Module Content:

This module aims to provide an introduction to microbiology with relevance to both the natural and engineered systems. It starts with a description of the possible origin of life, from the abiotic world to single-celled and multicellular organisms, and the ultrastructure of the prokaryotic and eukaryotic cells will be covered in detail. The diversity of life forms, from viruses to prokaryotic and eukaryotic microorganisms will be described. This course will serve as an introduction to the topic of environmental microbiology. Information about basic microbiology and biochemistry, and microbial ecology will be incorporated, providing the student with both an understanding of basic microbiology and of the potential of microorganisms to influence our environment. The topics addressed in the course include:

Introduction to microbiology

Microbiology & Microorganisms; Hallmarks of cellular life; Cell structure; Microorganisms and the Biosphere; The Impact of Microorganisms on Human; Microscopy and the Origins of Microbiology

Classification of microorganisms

Classification based on: Cell Morphology, Nutrients requirement; Environmental requirements; Phylogeny; Metabolic Diversity

Microbial cell structure and function

Size of Microbes; The Cytoplasmic Membrane; Transporting Nutrients into the Cell; Cell Motility; Chemotaxis and Other Taxes

Microbial metabolism

Feeding the Microbe: Cell Nutrition; Culture Media; Principles of Bioenergetics; Electron Donors and Acceptors

Microbial growth and its control

Binary Fission, Budding, and Biofilms; Quantitative Aspects of Microbial Growth; The Microbial Growth Cycle; Kinetics of growth (Monod equation); Bacterial growth in continuous culture; Culturing Microbes and Measuring Their Growth; Environmental Effects on Growth; Controlling Microbial Growth

Metabolic Diversity of Microorganisms

Photosynthesis; Anoxygenic Photosynthesis; Oxygenic Photosynthesis; Autotrophic Pathways; Nitrogen Fixation; Respiratory Processes Defined by Electron Donor; Respiratory Processes Defined by Electron Acceptor

Microbial Ecosystems & Nutrient Cycles

Carbon, Nitrogen, and Sulfur Cycles; Other Nutrient Cycles; Humans and Nutrient Cycling

Microbiology of the Built Environment

Public Health and Water Quality; Wastewater and Drinking Water Treatment; Indoor Microbiology and Microbially Influenced Corrosion

Learning Outcomes:

LO1. Provide an account of the cellular basis of life: from its origins in the abiotic world, to the evolution of unicellular and multicellular organisms.

LO2. Describe the diversity of life forms: including viruses, Prokaryotes (bacteria), Archaea, and Eukaryotes (unicellular organisms, animals and plants).

LO3. Differentiate microorganisms according to their metabolism (e.g., electron acceptors, electron donors and carbon source).

LO4. Employ a range of laboratory techniques, demonstrating the development of practical scientific skills, knowledge of experimental design and the interpretation of results.

LO5. Apply the scientific method as a fundamental approach to experiment- based investigations, critical analysis of data, and problem solving.

LO6. Outline the diversity of life on earth and describe how it evolved over geological time scales. LO6. Describe the ecological relationships between microbial communities and ecosystems.

LO7. Explain how microorganism can positively and negatively influence other living organisms and their environment and understand the value of microorganisms for humans.

LO8. Collate, synthesise, organise and present information in written reports.

Recommended Reading:

Brock's Biology of Microorganisms, 15th Edition – Madigan et al. [Pearson].

Environmental Biotechnology: Principles and Applications, Second Edition - Bruce Rittmann, Perry McCarty

Module Code: **MAU11E02**

Module Name: **Engineering Mathematics II**

ECTS: **5 ECTS**

Semester Taught: **Semester 2**

Teaching Staff: **Dr. Chaolun Wu (wuch@tcd.ie)**

Module Content:

Evaluation of integrals;

Notion of a differential equation;

Polynomials, sequences and series including simple convergence tests, Taylor and Maclaurin Series;

Vectors and their use for describing lines and planes in space, scalar and cross products;

Gaussian elimination;

Matrix algebra;

Theorems on existence of matrix inverses;

Determinants.

Learning Outcomes:

1. Integrate by parts, integrate trigonometric and rational functions;

2. Use integration to solve geometrical problems, such as finding volumes, areas and lengths;

3. Evaluate improper integrals;

4. Formulate and solve a first order differential equations;

5. Determine if a sequence converges or not;

6. Test a series for convergence;

7. Approximate a function by polynomials;

8. Apply vectors to geometrical problems in space;

9. Calculate solutions to systems of linear equations and find inverse matrices by different methods, and describe why some methods are more efficient than others

Recommended Reading:

Single Variable Calculus 7th ed. Early Transcendentals by James Stewart. (For integrals, sequences, series, differential equations)

Multivariable Calculus 7th ed. Early Transcendentals by James Stewart. (For vectors in R3 and equations of planes)

Linear Algebra and its applications, David Lay, 4th ed., Pearson 2012.

Module Code: **PYU11E04**

Module Name: **Physics**

ECTS: **5 ECTS**

Semester Taught: **Semester 2**

Module Coordinator/s: **Prof. Stefan Hutzler**

Prof. Hongzhou Zhang

Module Content:

Thermal Physics

Temperature (including kinetic gas theory), temperature scales, thermometers, thermal expansion, laws of thermodynamics, ideal and real gases, isochoric and isobaric heat capacity, thermodynamic potentials, thermodynamic cycles (including clockwise and anti-clockwise Carnot cycle); heat transfer, conduction, convection, radiation.

Geometric Optics

Mirrors, lenses and prisms, reflection, refraction, polarisation, interference/diffraction, image formation, simple optical systems

Oscillations and Waves

Oscillator equation of motion, simple harmonic oscillator, damping, properties of waves, wave-equation, travelling and stationary waves, superposition-principle, Huygens principle, diffraction, interference, and polarisation, electromagnetic and sound waves.

Electricity and Magnetism

Introduction to electrostatics, magnetostatics and electromagnetism: electric charge, Coulomb's law, concepts of electrical field and potential, energy, Biot-Savart Law, Ampere's Law, magnetic fields, Lorenz Force, Electromagnetic induction and Faraday's Law, summary of Maxwell equations

Learning Outcomes:

1. Explain the basic physical laws describing thermodynamic processes, heat and heat-transfer, oscillations and waves (including light and sound), electricity and magnetism
2. Apply basic physical laws to technologically relevant examples
3. Explain measurement principles and use these to investigate physical phenomena
4. Demonstrate good laboratory practice and precise written reporting procedures

Recommended Reading:

University Physics, Young and Freedman, 12th edition

Module Code: **GSU11005**

Module Name: **Introduction to Geology: A Beginner's Guide to Planet Earth**

ECTS: **10 ECTS**

Semester Taught: **Semester 2**

Module Coordinator/s: **Dr Christopher Nicholas (christopher.nicholas@tcd.ie)**

Module Content:

This Module is a 'Beginner's Guide' to our dynamic planet, Earth, and the science of Geology. It explains the natural principles and processes which govern how Planet Earth works inside and out, and then retraces its geological history over the past four and a half billion years.

From the vastness of space, to the microscopic crystal structure of minerals; from events which take billions of years, like galaxy formation, to volcanic eruptions which may last only minutes or seconds. Geology, or Earth Science, is the all-encompassing study of Planet Earth. Geology sets out to investigate the origin and development of the planet, the natural principles that govern it, the processes that act in it, on it, and around it, and finally the life that has evolved with it. Many sciences are conducted in the laboratory, but to a geologist, the Earth itself is the laboratory. The module is organised into two main themes. Firstly, we will look at 'Earth In Space'. We live on a dynamic and ever-changing planet, where the surface is constantly being destroyed and renewed. This theme looks at the origin of the Earth, what it's made of and the processes at work, inside and out, which drive this change. The second theme, 'Earth In Time', then focuses on the evolution of the planet over time, and the life that has evolved with it. Earth has been around for just over 4,500 000 000 years, and remarkably, we have evidence that life has existed for at least 3,800 000 000 of those years. There are times in Earth's history when geological events have changed the course of biological evolution. And, perhaps more intriguingly, there are times when life has changed the way the planet operates. So, this theme of Earth and Life evolving together through geological time is illustrated by looking at eight key episodes in Earth's history, without which, we simply wouldn't be here.

Learning Outcomes:

1. Outline the origin and evolution of planet Earth
2. Describe and illustrate the dynamic nature of planet Earth with reference to specific geological processes
3. Describe the origins of life on Earth and list the major evolutionary episodes evident in the fossil record
4. Explain the links between the evolution of life and environmental conditions on planet Earth
5. Outline the geological history of the island of Ireland
6. Make basic geological observations, measurements and interpretations in the field and laboratory.

Recommended Reading:

Nicholas, C. J., 2017. A Beginner's Guide to Planet Earth: Introductory Lectures in Geology. C.J. Nicholas (ISBN 978-1-911180-33-3)

Academic Year Calendar 2024/25

Academic Calendar Week	Week beginning	2024/25 Academic Year Calendar		Term / Semester
		UG continuing years / PG all years	UG new first years	
1	26-Aug-24	Reassessment * (Semesters 1 & 2 of 2023/24)		←Michaelmas Term begins/Semester 1 begins
2	02-Sep-24	Orientation (Postgraduate, Visiting & Erasmus); Marking/Results		
3	09-Sep-24	Teaching and Learning		←Michaelmas teaching term begins
4	16-Sep-24	Teaching and Learning	Orientation (JF UG)	
5	23-Sep-24	Teaching and Learning	Teaching and Learning	
6	30-Sep-24	Teaching and Learning	Teaching and Learning	
7	07-Oct-24	Teaching and Learning	Teaching and Learning	
8	14-Oct-24	Teaching and Learning	Teaching and Learning	
9	21-Oct-24	Study/Review	Study/Review	
10	28-Oct-24	Teaching and Learning (Monday, Public Holiday)	Teaching and Learning (Monday, Public Holiday)	
11	04-Nov-24	Teaching and Learning	Teaching and Learning	
12	11-Nov-24	Teaching and Learning	Teaching and Learning	
13	18-Nov-24	Teaching and Learning	Teaching and Learning	
14	25-Nov-24	Teaching and Learning	Teaching and Learning	
15	02-Dec-24	Revision *[1]	Revision *[1]	
16	09-Dec-24	Assessment *[1]	Assessment *[1] ~	←Michaelmas term ends Sunday 15 December 2024/Semester 1 ends
17	16-Dec-24	Christmas Period - College closed 24 December 2024 to 1 January 2025 inclusive	Christmas Period - College closed 24 December 2024 to 1 January 2025 inclusive	
18	23-Dec-24			
19	30-Dec-24			
20	06-Jan-25	Foundation Scholarship Examinations ^		
21	13-Jan-25	Marking/Results	Marking/Results	←Hilary Term begins/Semester 2 begins
22	20-Jan-25	Teaching and Learning	Teaching and Learning	←Hilary teaching term begins
23	27-Jan-25	Teaching and Learning	Teaching and Learning	
24	03-Feb-25	Teaching and Learning (Monday, Public Holiday)	Teaching and Learning (Monday, Public Holiday)	
25	10-Feb-25	Teaching and Learning	Teaching and Learning	
26	17-Feb-25	Teaching and Learning	Teaching and Learning	
27	24-Feb-25	Teaching and Learning	Teaching and Learning	
28	03-Mar-25	Study/Review	Study/Review	
29	10-Mar-25	Teaching and Learning	Teaching and Learning	
30	17-Mar-25	Teaching and Learning (Monday, Public Holiday)	Teaching and Learning (Monday, Public Holiday)	
31	24-Mar-25	Teaching and Learning	Teaching and Learning	
32	31-Mar-25	Teaching and Learning	Teaching and Learning	
33	07-Apr-25	Teaching and Learning	Teaching and Learning	
34	14-Apr-25	Revision (Friday, Good Friday)	Revision (Friday, Good Friday)	←Hilary Term ends Sunday 20 April 2025
35	21-Apr-25	Assessment *[2] (Monday, Easter Monday)	Assessment *[2] (Monday, Easter Monday)	←Trinity Term begins
36	28-Apr-25	Trinity Week (Monday, Trinity Monday) *[2]	Trinity Week (Monday, Trinity Monday) *[2]	
37	05-May-25	Marking/Results (Monday, Public Holiday)	Marking/Results (Monday, Public Holiday)	
38	12-May-25	Marking/Results	Marking/Results	
39	19-May-25	Marking/Results	Marking/Results	
40	26-May-25	Research	Research	←Trinity Term ends Sunday 1 June 2025/Semester 2 ends
41	02-Jun-25	Research (Monday, Public Holiday)	Research (Monday, Public Holiday)	
42	09-Jun-25	Research	Research	
43	16-Jun-25	Research	Research	
44	23-Jun-25	Research	Research	
45	30-Jun-25	Research	Research	
46	07-Jul-25	Research	Research	
47	14-Jul-25	Research	Research	
48	21-Jul-25	Research	Research	
49	28-Jul-25	Research	Research	
50	04-Aug-25	Research (Monday, Public Holiday)	Research (Monday, Public Holiday)	
51	11-Aug-25	Research	Research	
52	18-Aug-25	Research +	Research +	

* Note: additional/contingency days may be required outside of the formal assessment/reassessment weeks.
~ Note: it may be necessary to hold a small number of JF examinations/assessments outside of semester 1.
^ Note: it may be necessary to hold some examinations/assessments in the preceding week.
*[1] Note: semester 1 Assessment session: 09-Dec-24 to 14-Dec-24 inclusive (contingency dates during week beginning 02-Dec-24 TBC)
*[2] Note: semester 2 Assessment session: 22-Apr-25 to 02-May-25 inclusive (includes Council approved contingency dates: 29-Apr-25 to 02-May-25)
+ Note: the academic year structure is due to be reviewed during 2024/25 - any changes will be notified should Council approve any change.

The academic year calendar 2024/25 can be viewed at:

https://www.tcd.ie/calendar/

Assessment and Examination

Examination Dates 2024/25:

Semester 1 assessment dates commence the week beginning 9th December 2024.

Semester 2 assessment dates commence the week beginning 21st April 2025.

Notes:

Additional/contingency days may be required outside of the formal assessment/reassessment weeks.

It may be necessary to hold a small number of JF examinations/assessments outside of semester 1.

It may be necessary to hold some examinations/assessments in the preceding week.

Assessment across both the undergraduate and postgraduate elements of the course will be carried out by a variety of different methods as exemplified below:

Conventional end of term exams

Laboratory practicals

Marked tutorials

Reflective diaries

Group design projects

Team based assessment

Independent research project (year 5)

Conduct of examinations and submission of assessed work

The below is taken from the College Calendar, Part II, pages 35-37, 39 and is edited to include information specific to progression in Environmental Science and Engineering.

34 .Programmes have discretion to utilise a broad range of assessment practices that are programme-focussed, equip students to apply their learning in contexts beyond the University and assess the graduate attributes appropriately throughout the programme. An assessment component is a discrete unit of assessment, e.g. an examination paper, an essay, an oral/aural examination, practical, field trip, professional placement, or performance which contributes a defined weighting to the overall assessment for a module. Programmes must make available to students details of the assessment components, together with their weightings, for each module, including details of penalties applying for late submission.

35.Students are entitled to receive feedback on submitted coursework in line with the Return of Coursework Policy. See www.tcd.ie/teaching-learning/academic-policies.

36. There are formal University assessment sessions following the end of teaching term in semester one (in Michaelmas term) and following the end of teaching term in semester two (in Trinity term). Students are assessed at the end of semester one in all modules that are taught only in semester one and at the end of semester two in all year-long modules and all modules that are taught only in semester two. There is one reassessment session which is held at the beginning of Michaelmas term. Students are assessed in all failed modules from both semesters during the reassessment session.

The University reserves the right to amend assessment methods and the timetable for assessments for any reason and at any stage during the academic year. All teaching and assessments are subject to public health advice and guidance as and when issued.

37 The dates of these formal assessment sessions are given in the Calendar PART I - ALMANACK. Examinations should be confined to these sessions. However, if and when approved by the University Council, certain courses, normally professional, are permitted to hold examinations outside of the standard academic year structure. The University Council may also approve additional contingency dates on which to hold examinations outside of the standard academic year structure.

38 Examination timetables are published four weeks in advance of the formal start date of each assessment period on the my.tcd.ie portal. The College reserves the right to alter the published time and date of an examination in exceptional circumstances. Students should ensure that they are available for examinations for the duration of the relevant formal assessment session and approved contingency dates as stated in the Calendar PART I - ALMANACK.

39 No notice is required of intention to take an end-of-semester examination or to sit for reassessment in the course for which students have registered.1 The onus lies on each student to establish the dates, times, mode and venue of examinations by consulting the relevant timetable on the my.tcd.ie portal. No timetable or reminder will be sent to individual students by any office

40 Except as provided for below, candidates for examination are forbidden during an examination to do or to attempt to do, any of the following: to have in their possession or consult or use any books, papers, notes, memoranda, mobile phones, electronic devices, or written or electronic material of any nature, or to copy from or exchange information with other persons, or in any way to make use of any information improperly obtained.

41 Where the examination is of such a nature that materials are provided to the candidates, or where the candidates are allowed by the rules of that examination to have materials in their possession, then candidates may only make use of such materials, and the general prohibition above continues to apply in respect of any and all other materials.

42 Where candidates have the prior written permission of the examiner(s), of the Senior Lecturer, or of the Disability Officer, to have materials in their possession during an examination, then candidates may only make use of such materials, and the general prohibition above continues to apply in respect of any and all other materials.

43 Candidates may be allowed to bring personal belongings to examination venues upon condition that such belongings are stored in designated areas. Candidates must ensure that they store their belongings

accordingly and must not return to them until they have finished their examinations and are leaving the venue.

44 Any breach of this regulation is regarded as a major offence for which a student may be expelled from the University (see §4 under CONDUCT AND COLLEGE REGULATIONS).

45 Students must not leave the examination before the time specified for the examination has elapsed, except by leave of the invigilator.

46 The College has approved the practice of anonymous marking for undergraduate examinations at the formal assessment and reassessment sessions.

47 All undergraduate results are published by student number. The results for assessments completed in semester one are provisional until moderated by the court of examiners in Trinity term. The end of year or degree result moderated by the court of examiners must be returned and recorded on the student record.

48 Students are required to complete the assessment components for each module as prescribed by the programme regulations. See Assessment: procedures for the non-submission of course work and absence from examinations at www.tcd.ie/teaching-learning/academicpolicies.

49 Students are not permitted to repeat successfully completed assessments or examinations in order to improve their performance.

50 The Board of the College reserves the right to exclude from the College, on the recommendation of the University Council, students whose academic progress is unsatisfactory

51 Students who are unable to complete such assessment components necessary to complete a module or modules at the end of the appropriate semester due to certified illness, disability, or other grave cause beyond their control may seek, through their tutor, permission from the Senior Lecturer to present at the reassessment session. Where certified illness, disability, or other grave cause beyond their control prevents a student from completing at the reassessment session they may seek, through their tutor, permission from the Senior Lecturer to repeat the year.

52 Students who may be prevented from sitting an examination or examinations (or any part thereof) due to illness should seek, through their tutor, permission from the Senior Lecturer in advance of the assessment session to defer the examination(s) to the reassessment session. Students who have commenced the assessment session, and are prevented from completing the session due to illness should seek, through their tutor, permission to defer the outstanding examination(s)/assessment(s) to the reassessment session. In cases where the assessment session has commenced, requests to defer the outstanding examination(s) on medical grounds, should be submitted by the tutor to the relevant school/departmental/course office. If non-medical grounds are stated, such deferral requests should be made to the Senior Lecturer, as normal.

53 Where such permission is sought, it must be appropriately evidenced: (a) For illness: medical certificates must state that the student is unfit to sit examinations/ complete assessments and specify the date(s) of the illness and the date(s) on which the student is not fit to sit examinations/complete assessments. Medical certificates must be submitted to the student's tutor within three days of the beginning of the period of absence from the assessment/examination. (b) For other grave cause:

appropriate evidence must be submitted to the student's tutor within three days of the beginning of the period of absence from the assessment/examination.

54 Where illness occurs during the writing of an examination paper, it should be reported immediately to the chief invigilator. The student will then be escorted to the College Health Centre. Every effort will be made to assist the student to complete the writing of the examination paper.

55 Where an examination/assessment has been completed, retrospective withdrawal will not be granted by the Senior Lecturer nor will medical certificates be accepted in explanation for poor performance.

56 If protracted illness prevents a student from taking the prescribed assessment components, so that they cannot rise into the next class, they may withdraw from College for a period of convalescence, provided that appropriate medical certificates are submitted to the Senior Lecturer. If the student returns to College in the succeeding academic year they must normally register for the year in full in order to fulfil the requirements of their class. See §26 on fitness to study and §28 fitness to practise, if relevant.

57 Where the effects of a disability prevent a student from taking the prescribed assessment components, so that they cannot rise into the next class, the Senior Lecturer may permit the student to withdraw from College for a period of time provided that appropriate evidence has been submitted to the Disability Service. If they return to College in the succeeding academic year they must normally register for the year in full in order to fulfil the requirements of their class. 58 The nature of non-standard examination accommodations, and their appropriateness for individual students, will be approved by the Senior Lecturer in line with the Council-approved policy on reasonable accommodations. Any reports provided by the College's Disability Service, Health Service or Student Counselling Service will be strictly confidential.

Access to Scripts and other assessed work

All students have a right to discuss their examination and assessment performance with the appropriate members of staff. This right is basic to the educational process. Students are entitled to view their scripts and other assessments when discussing their performance. For work completed during semester one students should note that all results are provisional until moderated by the court of examiners in Trinity term. In Trinity term, students' performance cannot be discussed with them until after the publication of the end-year results.

Written assessment components and assessment components which are recorded by various means (e.g. video, audio) are retained by schools and departments for thirteen months from the date of the meeting of the court of examiners which moderates the results in question and may not be available for consultation after this time period.

Re-check/re-mark of examination scripts and other assessed work

Having received information about their final results at the court of examiners in Trinity term and having discussed these and their performance with the Director of Teaching and Learning (Undergraduate) or the

head of discipline and/or the appropriate staff, students may ask that their results be reconsidered if they have reason to believe:

(a) that the grade is incorrect because of an error in calculation of results;

(b) that the examination paper or other assessment specific to the student's course contained questions on subjects which were not part of the course prescribed for the examination or other assessment; or

(c) that bias was shown by an examiner in marking.

In the case of (a) above, the request should be made through the student's tutor to the Director of Teaching and Learning (Undergraduate) or course director as appropriate.

In the case of (b) and/or (c) above, the request should be made through the student's tutor to the Senior Lecturer. In submitting such a case for reconsideration of results, students should state under which of (b) and/or (c) the request is being made.

Requests for re-check or re-mark should be made as soon as possible after discussion of results and performance and no later than twelve months from the date of the meeting of the court of examiners which moderated the marks in question.

Once a result has been formally published following the court of examiners it cannot be amended without the permission of the Senior Lecturer.

Any student who makes a request for re-check or re-mark that could have implications for their degree result is advised not to proceed with degree conferral until the outcome of the request has been confirmed.

Academic Progress (Specific to Environmental Science and Engineering)

Year 1-4:

Progression regulations Year 1 to Year 4 are standard (grade of 40 per cent or more to progress). However, in order to be eligible to undertake an industry internship or international exchange in Year 4, students must achieve a threshold grade of 60 per cent at the end of Year 3. Students who don't achieve 60 per cent in Year 3 may still progress to Year 4 with a grade of 40 per cent or above but they must take a capstone module in Year 4 and spend the full year in Trinity.

Year 5:

Progression will be an annual basis. Progression from Year 4 to Year 5 will require a minimum overall mark of 60% for the combined Junior Sophister and Senior Sophister years (on a 30:70 basis) at the annual assessment session of the B.Sc. degree year.

In year 5, students will be able to carry failed modules from semester to semester. Progression through year 5 leading to the final awards of M.A.I. (St.) and Master in Applied Environmental Science depending on the route chosen, requires a 50% pass grade for award of pass degree on the results of students continuous assessment and examinations. The award of distinction degree shall require at least 70 per

cent in both examinations and the dissertation and at least 70 per cent in the final credit weighted average.

Attendance:

All students should enter into 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 department notice-boards 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.

The requirements for attendance at lectures and tutorials vary between the different faculties, schools and departments. Attendance is compulsory for Junior Freshmen in all subjects. The school, department or course office, whichever is relevant, publishes its requirements for attendance at lectures and tutorials on notice-boards, and/or in handbooks and elsewhere, as appropriate.

Prizes and Scholarships

Foundation Scholarship

Foundation Scholarship is a College institution with a long history and high prestige. The objective of the Foundation Scholarship examination is to identify students who, at a level of evaluation appropriate to the Senior Freshman year, can consistently demonstrate exceptional knowledge and understanding of their subjects. The questions that are asked in the engineering scholarship exams are very challenging. They test a student's ability to think laterally, to solve unfamiliar problems and to tackle problems from first principles. Although the syllabi for the scholarship exams and the end of year exams are the same, the nature of the questions in the scholarship exams is more challenging. A good scholarship question will require a creative leap or a deep insight of the fundamental principles. The most important skill that is developed in an engineering education is problem solving. The most difficult problems to solve are those that are unfamiliar, that require a fundamental understanding of the basic principles and that require the student to make a creative or innovative leap.

Book Prizes

A prize of a book token to the value of €13 is awarded to candidates who obtain a standard equivalent to an overall first class honors grade (70% and above) at the first attempt of the semester 1 and semester 2 assessment. Book Prizes will be available 21 for collection in November of the following academic year

from the Academic Registry. These prizes are issued in the form of book tokens and can be redeemed at Hodges Figgis and Co. Ltd..

Plagiarism

To ensure that you have a clear understanding of what plagiarism is, how Trinity deals with cases of plagiarism and how to avoid it, you will find a repository of information at https://libguides.tcd.ie/academic-integrity

We ask you to take the following steps:

Visit the online resources to inform yourself about how Trinity deals with plagiarism and how you can avoid it at https://libguides.tcd.ie/academic-integrity. You should also familiarize yourself with the 2023/24 Calendar entry on plagiarism located on this website and the sanctions which are applied.

Complete the 'Ready, Steady, Write' online tutorial on plagiarism at https://libguides.tcd.ie/academic-integrity/ready-steady-write. Completing the tutorial is compulsory for all students.

Familiarise yourself with the declaration that you will be asked to sign when submitting course work at https://libguides.tcd.ie/academic-integrity/declaration.

Contact your College Tutor, your Course Director, or your Lecturer if you are unsure about any aspect of plagiarism.

Ethics

In line with Trinity College Dublin's Policy on Good Research Practice, all research in the School of Natural Sciences (SNS) should be conducted according to the overarching ethical principles of "respect for the individual subject or population, beneficence and the absence of maleficence (research should have the maximum benefit with minimal harm) and justice (all research subjects and populations should be treated fairly and equally)."

All individuals involved in research should facilitate and ensure research is conducted ethically. Ethical conduct in research is a shared responsibility. Primary responsibility rests with the Principal Investigator(s). Ethical responsibilities and legal obligations may overlap. All staff and students conducting research are required to ensure that their research is carried out in compliance with this policy. Ethical review is required before any studies involving human subjects, other living organisms and natural or man-made habitats commence. For field work, ethical consideration needs to be given to the disturbance of species and habitats that may not be subject of your particular study, ethical considerations also need to apply to access to private land. This requirement applies to staff, postgraduate and undergraduate students and volunteers/interns. Field- and laboratory work cannot commence until review has been completed and/or approval has been gained. STUDENTS PLANNING TO UNDERTAKE RESEARCH SHOULD COMPLETE THE **SNS Research Ethics Application.** .

For further details please follow this link: www.naturalscience.tcd.ie/research/ethics

Use of AI tools in academic work

Statement prepared by Dr Sylvia Caldararu

In recent years, we have seen the rise of AI tools, including text and image generation tools, information mining and many more. Such tools are now becoming embedded in search engines and PDF readers such as Adobe. If and how to use AI in academic and scientific work is still a matter of debate in the scientific community, and opinions evolve as the algorithms themselves evolve. At College level, the use of AI falls under the general Academic Integrity policy and associated regulations. Due to the rapidly changing nature of the field of AI, students are advised to keep up to date with this policy as it might change through the academic year.

AI tools are increasingly being incorporated into workflows in professional contexts and it is important that you familiarise yourself with what AI can do and what are its limitations and pitfalls. Keep in mind that a lot of information available on the topic on the internet is biased and produced by individuals and companies that are trying to sell AI products or by people who are, rightfully, angry that their work has been used for AI training without their consent (see 'Ethical concerns' below).

The below is meant to serve as an explainer of what AI and its various forms are and of the possible caveats of using AI tools in your academic work and beyond.

Definitions

Artificial Intelligence (AI) – In its more general and futuristic definition, artificial intelligence algorithms are those that provide human-like or beyond human-like interpretation in a way that looks like the output of human intelligence. In its present-day use, the term refers to mathematical algorithms that use advanced statistical methods to find patterns in the data provided (numbers, text, images, etc) and create the desired output.

Training data – data that is used for an AI algorithm to 'learn' the patterns in the data and create the actual AI model that creates the output and is provided to users.

Generative AI (GenAI) – AI algorithms that can create new content based on given training data, including text, images, sound and videos.

Large Language Models (LLM) – a generative AI algorithm that creates text in natural language. The best known one is ChatGPT but there are many more out there with various uses.

Machine learning (ML) – largely synonymous with AI but more frequently used in scientific papers specifically about developing or applying algorithms. You will see, for example, studies using ML to identify plant species or to scale up measurements to areas where these measurements are not available.

Accuracy concerns

LLMs are built to mimic human language, and a model is considered good if the output looks convincingly like language. There is nothing in the LLM's training to check if the information in the text is true or accurate. The model has been trained on real text, so there is a chance that the output contains actual information, but there is also a chance that it doesn't. If asked to include reference in the text, LLMs will frequently make up plausible looking but non-existent references. While there are efforts being made to integrate LLMs with real search engines, no reliable and accurate LLM exists at the time of writing this explainer.

Ethical concerns

All AI algorithms need training data. There are of course ways to obtain such data in equitable ways, but in practice AI companies have used, art, literature, journalism and academic text without obtaining permission or paying the original authors.

Environmental concerns

Training AI algorithms requires large amounts of computational power, which in turn require a lot of energy and water. Serious concerns have been raised around the climate impact of training and using AI. As scientists and especially scientists working in the natural sciences, we cannot ignore these facts.

Should I use AI in my academic work?

There is no right or wrong answer to this question. Writing your entire assessment using an LLM will most certainly fall under the College Academic Integrity policy. Using machine learning as a statistical method for your research project will most certainly not and might create a very exciting and state of the art project. Beyond that, use your judgment, keeping in mind the caveats above. Some modules will have a specific AI policy, and you should follow that. If in doubt, do not hesitate to ask the module coordinator.

Marking

	Criteria
90-100	Exceptional Answer; This answer will show original thought and a sophisticated insight into the subject, and mastery of the available information on the subject. It should make compelling arguments for any case it is putting forward, and show a rounded view of all sides of the argument. In exam questions, important examples will be important examples will be supported by attribution to relevant authors, and while not necessarily giving the exact date, should show an awareness of the approximate period. In essays, the referencing will be comprehensive and accurate.supported by attribution to relevant authors, and while not necessarily giving the exact date, should show an awareness of the approximate period. In essays, the referencing will be comprehensive and accurate.
80-89	OUTSTANDING ANSWER; This answer will show frequent originality of thought and make new connections between pieces of evidence beyond those presented in lectures. There will be evidence of awareness of the background behind the subject area discussed, with evidence of deep understanding of more than one view on any debatable points. It will be written clearly in a style which is easy to follow. In exams
70-79	INSIGHTFUL ANSWER; showing a grasp of the full relevance of all module material discussed, and will include one or two examples from wider reading to extend the arguments presented. It should show some original connections of concepts. There will be only minor errors in examples given. All arguments will be entirely logical, and well written. Referencing in exams will be sporadic but referencing should be present
65-69	VERY COMPREHENSIVE ANSWER; good understanding of concepts supported by broad knowledge of subject. Notable for synthesis of information rather than originality. Evidence of relevant reading outside lecture notes and module work. Mostly accurate and logical with appropriate examples. Occasionally a lapse in detail.
60-64	LESS COMPREHENSIVE ANSWER; mostly confined to good recall of module work. Some synthesis of information or ideas. Accurate and logical within a limited scope. Some lapses in detail tolerated. Evidence of reading assigned module literature

55-59	SOUND BUT INCOMPLETE ANSWER; based on module work alone but suffers from a significant omission, error or misunderstanding. Usually lacks synthesis of information or ideas. Mainly logical and accurate within its limited scope and with lapses in detail..
50-54	INCOMPLETE ANSWER; suffers from significant omissions, errors and misunderstandings, but still with understanding of main concepts and showing sound knowledge. Several lapses in detail.
45-49	WEAK ANSWER; limited understanding and knowledge of subject. Serious omissions, errors and misunderstandings, so that answer is no more than adequate.
40-44	VERY WEAK ANSWER; a poor answer, lacking substance but giving some relevant information. Information given may not be in context or well explained, but will contain passages and words, which indicate a marginally adequate understanding.
30-39	MARGINAL FAIL; inadequate answer, with no substanceor understanding, but with a vague knowledge relevant to the question.
0-29	UTTER FAILURE; with little hint of knowledge. Errors serious and absurd. Could also be a trivial response to the misinterpretation of a question.

Student Supports

Trinity College provides a wide range of personal and academic supports for its students.

Your Tutor:

All registered full-degree undergraduate students are allocated a Tutor when starting in College. Your Tutor is a member of the academic staff who is appointed to look after the general welfare and development of all students in their care.

You should see your tutor whenever you have a question or are worried or concerned about any aspect of College life or your personal life, in particular if it is affecting your academic work. Everything you say to your tutor is in strict confidence. Unless you give them permission to do so, they will not give ant information to anybody else, whether inside College or outside (not to your parents/family for example).

Your Tutor can help you only if they know you are facing difficulties, so if you are worried about anything go and see your Tutor before things get out of hand. Whilst your Tutor may not be able to solve the underlying problem, they can help you find the best way to limit the impact of your situation on your College work. Tutors can help with academic advice, changing course, withdrawing from College, exam regulations, financial assistance and personal advice. If you cannot find your own tutor, you can contact the Senior Tutor (tel: 01 896 2551). Senior Tutor's website: https://www.tcd.ie/seniortutor/

Student Counselling Service:

While Trinity implements its phased reopening, the SCS continues to offer services by telephone and video call. Please email student-counselling@tcd.ie to request an appointment. Emergency consults are available weekdays.

The student Counselling Service, 3rd Floor, 7 – 9 Leinster Street, College.

Tel: 01 896 1407

Email: student-counselling@tcd.ie

Please check the website for more up to date information: http://www.tcd.ie/Student_Counselling

College Health Service

The College Health Service has changed the way it operates in order to minimize risk to our students and staff during this time of national crisis
To ensure your safety we have restricted access. Do not attend College Health without an appointment, appointments can be made over the phone.
Opening hours: between 9.30-12.00 and 14.00-16.00

The Health Centre is situated on Trinity Campus in House 47, a residential block adjacent to the rugby pitch.

Tel: 01 896 1591 or 01 896 1556

Web: https://www.tcd.ie/collegehealth/

Chaplaincy

The chaplains are representatives of the main Christian Churches in Ireland who work together as a team, sharing both the college chapel and the chaplaincy in House 27 for their work and worship.

Steve Brunn (Anglican Chaplain): brunns@tcd.ie; tel: 01 896 1402

Julian Hamilton (Methodist Chaplain): julian.hamilton@tcd.ie; tel: 01 896 1901

Alan O'Sullivan (Catholic Chaplain): aeosulli@tcd.ie; tel: 01 896 1260

Peter Sexton (Catholic Chaplain): sextonpe@tcd.ie; tel: 01 896 1260

Web: https://www.tcd.ie/Chaplaincy/

Trinity Disability Service

Disability Services, Declan Treanor

Room 2054, Arts Building

Email: askds@tcd.ie

Tel: 01 896 3111

Web: https://www.tcd.ie/disability/

Niteline

A confidential student support line run by students for students which is open every night of term from 9pm to 2.30am.

Tel: 1800 793 793

Web: https://niteline.ie/

Students' Union Welfare Officer

House 6, College

Email: welfare@tcdsu.org

Web: https://www.tcdsu.org/welfare

Undergraduate Programming Centre

The Programming Centre is available to all Computer Engineering students free of charge. The centre operates as a drop-in service where you can get help with any problems you might have with programming in your courses. For further information, please visit http://www.scss.tcd.ie/ugpc/.

Student Learning Development

Student Learning Development provides learning support to help students reach their academic potential. They run workshops, have extensive online resources and provide individual consultations. To find out more, visit their website at https://student-learning.tcd.ie/.

Student 2 student (S2S)

S2S offers trained Peer Supporters for any student in the College who would like to talk confidentially with another student, or just to meet a friendly face for a chat. The service is free and available to everyone. To contact a Peer Supporter you can email student2student@tcd.ie.

Web: https://student2student.tcd.ie/peer-support/.

Trinity Careers Service

As a Trinity College Dublin student you have access to information, support and guidance from the professional team of expert Careers Consultants throughout your time at Trinity. The support offered includes 'next step' career guidance appointments, CV and LinkedIn profile clinics and practice interviews.

Web: https://www.tcd.ie/Careers/.

Co-curricular activities

Trinity College has a significant number of diverse student societies which are governed by the Central Societies Committee. They provide information on the societies including how to get involved and even how to start your own society. See http://trinitysocieties.ie/ for more details. Students are encouraged to get involved. Trinity College also has a huge range of sports clubs which are governed by the Dublin University Athletic Club (DUCAC). Dublin University Central Athletic Club - Trinity Sport - Trinity College Dublin (tcd.ie) for more details.

Trinity College Students' Union

The Trinity College Students' Union (TCDSU) is run for students by students. TCDSU represents students at college level, fight for students' rights, look after students' needs, and are here for students to have a shoulder to cry on or as a friend to chat with over a cup of tea. Students of Trinity College are automatically members of TCDSU. It has information on accommodation, jobs, campaigns, as well as information pertaining to education and welfare.

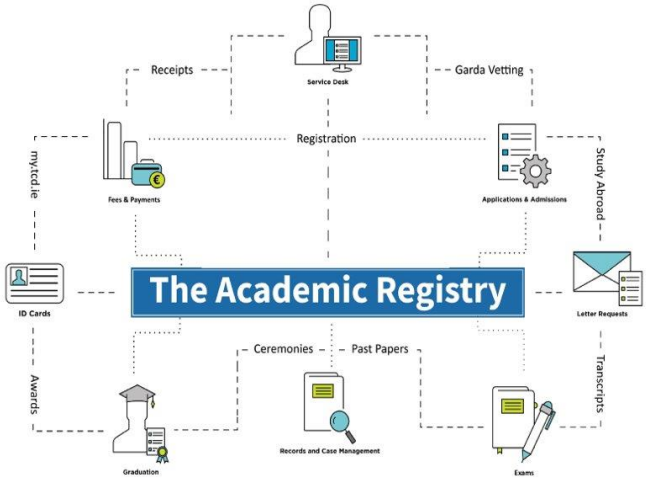
For more information see: https://www.tcdsu.org/.

Postgraduate Advisory Service

The Postgraduate Advisory Service offers free, independent, and confidential support, guidance and advocacy to registered postgraduate students. They are here to provide 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, financial assistance.

Academic Registry



The Academic Registry can help with queries on Applications & Admissions, Registration, ID Cards, Letter requests, Fees & Payments, Exams, Graduation, Fees & Payments. The Academic Registry is located in the Watts Building.

Telephone: 01 896 4500

Email: academic.registry@tcd.ie

Webchat: Academic Registry Webchat - Academic Registry - Trinity College Dublin (tcd.ie)

Website: https://www.tcd.ie/academicregistry/

Maths Supports

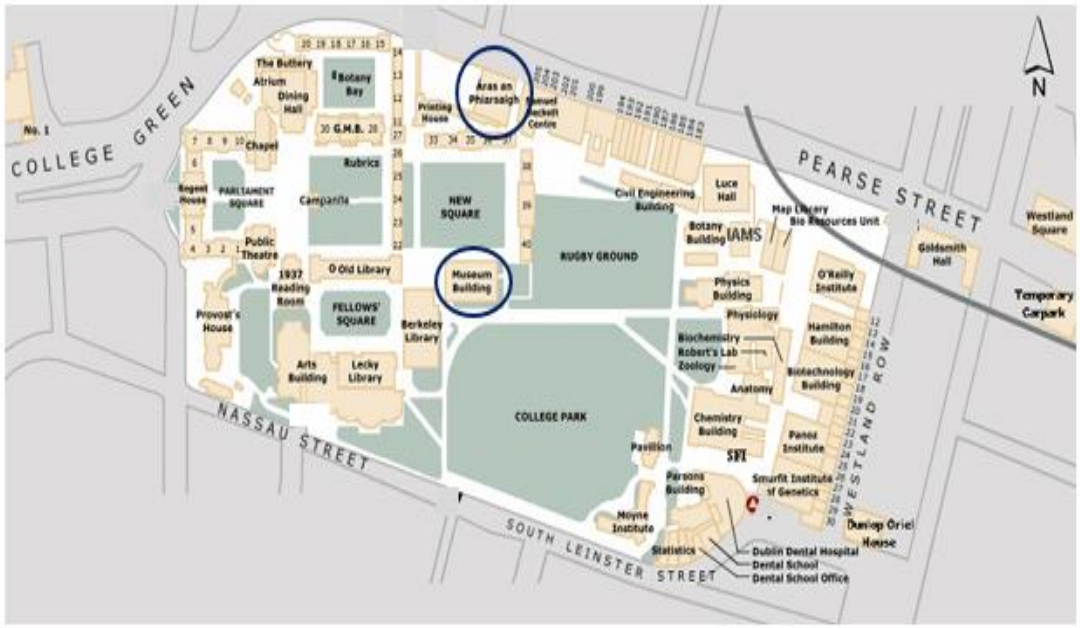
There is a Maths help room available which runs throughout the academic year on set days/times in which students can bring any problems or questions to tutors. The link can be found below:

https://www.maths.tcd.ie/outreach/helproom/

Maths Resources on Blackboard

https://student-learning.tcd.ie/blackboard/enrolment/

Key Campus Locations:



Interactive College Map

[College Maps : Trinity College Dublin (tcd.ie)]

General Information

Emergency Procedure

In the event of an+ emergency, **dial Security Services on extension 1999**

Security Services provide a 24-hour service 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 always telephone extension 1999 (+353 1 896 1999) in case of an emergency.

Should you require any emergency or 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

Trinity College Dublin uses personal data relating to students for a variety of purposes. We are careful to comply with our obligations under data protection laws and we have prepared this short guide to ensure you understand how we obtain, use and disclose student data in the course of performing University functions and services. The guidance note is intended to supplement the University's Data Protection Policy.

Further information can be found below:

Information Compliance : Trinity College Dublin (tcd.ie)

Staff Contacts

Staff	Email
Professor Jennifer McElwain – Course Director	jmcelwai@tcd.ie
Professor Laurence Gill - Course Director	laurence.gill@tcd.ie
Dr. John Hickey – CEU11E09	john.hickey@tcd.ie
Assistant Professor Patrick Fritzsch – MAU11E01	fritzscp@tcd.ie
Assistant Professor Muhammad Ali – CEU11E13	muhammad.ali@tcd.ie
Dr. Chaolun Wu – MAU11E02	wuch@tcd.ie
Professor Khurshid Ahmad –MEU11E08	khurshid.ahmad@scss.tcd.ie
Professor Stefan Hutzler – PYU11E04	Stefan.hutzler@tcd.ie
Assistant Professor Richard Hobbs – CHU11E05	hobbsr@tcd.ie
Dr Robin Edwards – GSU11004	robin.edwards@tcd.ie
Dr Christopher Nicholas – GSU11005	christopher.nicholas@tcd.ie
T.B.C Executive Officer (Room 4.29: Aras an Phiarsigh)	envscieng@tcd.ie
School of Natural Sciences - James Higgins (School Manager)	schoolofnaturalsciences@tcd.ie
School of Engineering	engineering@tcd.ie