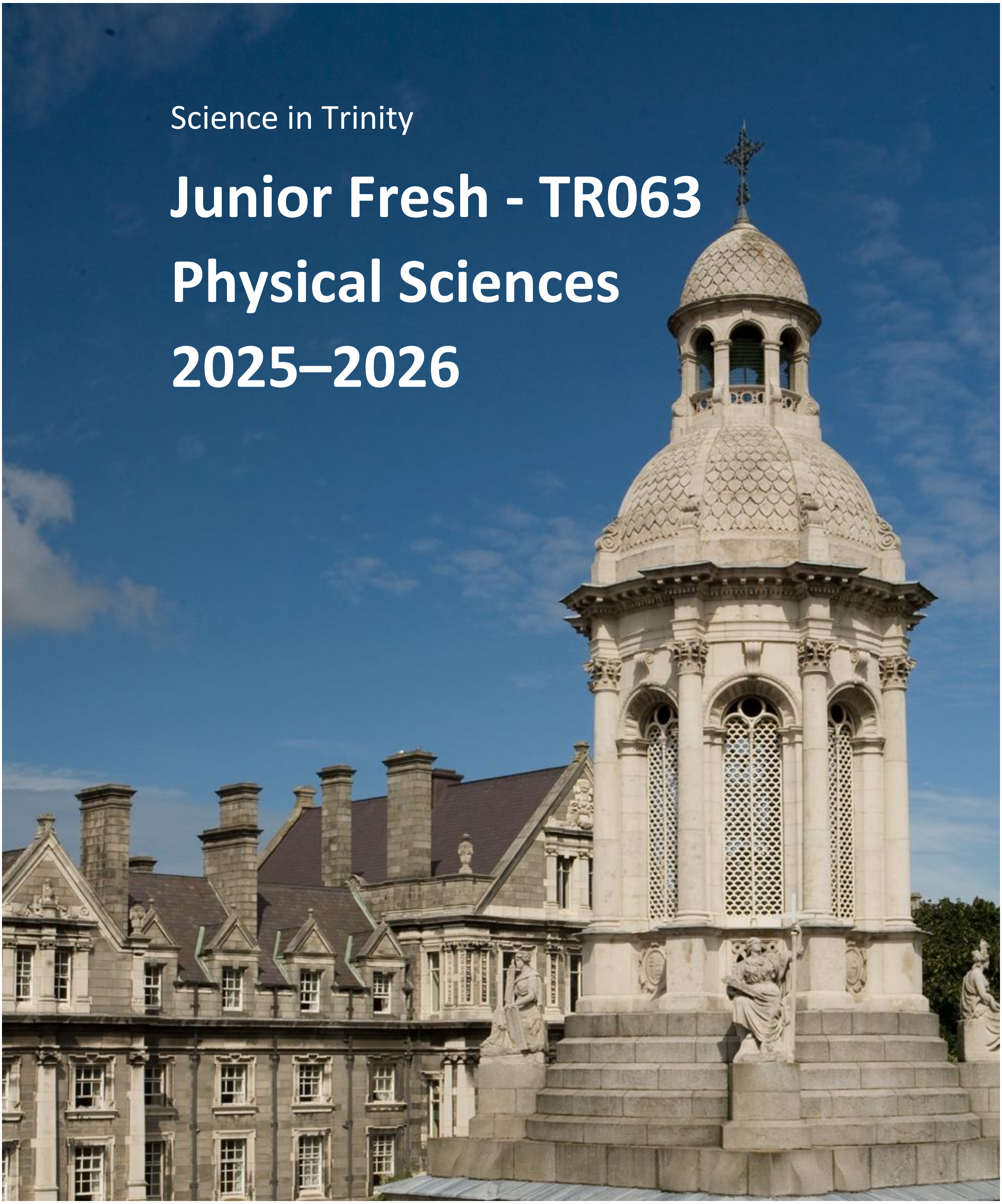
Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Science in Trinity

Junior Fresh - TR063
Physical Sciences
2025–2026



Contents

Welcome to Physical Sciences

Welcome to Physical Sciences – your entry to Physics, Physics and Astrophysics and Nanoscience.

There are all sorts of reasons why you might have chosen Physical Sciences as your preferred degree course. You might have chosen out of a love of physics, or perhaps because you have a facility with mathematics. Perhaps you are driven by curiosity about the world in which we live, and the pleasure of figuring out how it works. In the Physical Sciences course, you will have the opportunity to follow all these interests and more. We will help you cultivate a never-ending curiosity about the universe, whether this is at the largest scales of astrophysics, the smallest scales of particle physics, or the intermediate scales in which we live, and where our modern and future technology operates.

It may be that you have entered the course with the specific idea of graduating with one of the degrees, either in **Physics**, or in **Physics and Astrophysics**, or in **Nanoscience**. Perhaps you are planning to pursue a career in research in one of these areas. In Physical Sciences we would certainly encourage these dreams, but we will also prepare you for your future role in society and for many other careers, in industry and beyond. In every career move that you may make in the future your Physical Sciences degree will be useful, because it will have helped you develop transferable skills and attributes that are in demand by employers. Among these are problem solving skills, the ability to deal with complex mathematical and physical problems, and the use of the scientific method. You will learn scientific thought processes and critical thinking skills, and you will develop the Trinity Graduate Attributes that are important not just in many careers, but in many other areas of society.

Regardless of your personal motivations we would like to reassure you that you have chosen well, and that you will have many opportunities in the Physical Sciences course to reach your goals and potential – and that we will help you do this. This of course is with the proviso that you engage fully from the outset with the course, the materials, the laboratories, your peers, and the academic and other staff you encounter. In that sense you must be prepared to work effectively, collectively but ultimately independently. Your degree in the Physical Sciences course begins today!

The first two years of the Physical Sciences course cover the most essential topics necessary for each of the three possible degree routes in the final two years. In these "Fresher" years you will study Physics and Mathematics and one other subject. The Physics course includes topics in astrophysics, statistics, mechanics, thermodynamics, electricity and magnetism, optics, nuclear physics, quantum mechanics and special relativity. The Fresher Mathematics includes topics in calculus, linear algebra, differential equations, and Fourier analysis. As part of your Physics modules, you will spend three hours per week in experimental or computational laboratories learning coding skills through Python.

In the Sophister years all students will continue to develop foundational topics in physics to an advanced level, through courses on quantum mechanics, electromagnetism, and statistical mechanics. This is applied to atomic physics, and condensed matter physics. In addition to this common core, students taking **Physics** take courses on semiconductors, nuclear and particle physics and can choose from a range of specialist courses, covering areas such as photonics and modern optics, nanoscience and polymer physics, magnetism and superconductivity, several astrophysics topics, energy science, and quantum optics and information. Students specializing in **Physics and Astrophysics** instead take courses on stellar & galactic structure, planetary and space science, interstellar medium, astrophysical instrumentation and on cosmology, as well as optional courses. Students specializing in **Nanoscience** will study the most relevant courses at the boundaries of physics and chemistry best described by nanoscience, involving advanced modules in solid state chemistry, materials chemistry, condensed matter physics and further optional modules from the Schools of Physics and Chemistry.

In addition, all students in the Physical Sciences stream will use computers for numerical modelling via the Python programming language and learn how to use a range of physical instruments for making measurements in the laboratory. Students in the third year take a course in communication skills which helps them to hone their oral and written presentation skills and shows them how to prepare a curriculum vitae. Third year students can meet graduates of the School of Physics through the 'Wild Geese' GradLink program where they receive guidance on building their careers.

All students in the fourth year undertake a nine-week full time capstone research project, which is carried out in a research laboratory in Trinity or in a research lab in another university or research institute. Students commonly travel to the US, UK, France, Germany, and Australia for their final year projects. Students specializing in Physics and Astrophysics may travel to a telescope observatory.

Trinity Physical Science degrees are accredited by the Institute of Physics, the professional body for physicists in Ireland and the UK, as a basis for the professional status 'Chartered Physicist' (CPhys). Our graduates are always in high demand in Ireland, abroad and in modern high-tech industries, as well as in teaching. You may also find careers in academic institutions, government and industrial research organizations, high tech production facilities or in the meteorological service. Diverse opportunities in electronics, telecommunications, biophysics, hospital and health physics, automation and computing are always available The Physical Sciences courses will allow you to acquire problem-solving skills, appraise complex data, apply critical thinking, and use creativity, all of which will be highly valued by your future employer. It could also give you useful primary training for a legal, managerial, or actuarial career, where a technical background is attractive.

Professor Plamen Stamenov
Director, TR063 Physical Sciences Course

TR063 Physical Sciences Overview and Module Selection

Module choices will be made online. Prior to selecting modules, you should read this booklet, in particular pages 3-7, and then go to the https://forms.office.com/r/VH9mjbFp42 to select your modules. The forms will not open until the information session is finished, **15th September 14.00 hrs,** and it will **close on the 16th of September 14.00 hrs.** If you feel that you need assistance with your choices, please contact us at jfsco@tcd.ie, and we will be happy to help.

Please note that the module choices you make at the start of your Junior Fresh year determine your choices in the second semester of Junior Fresh year and throughout the Senior Fresh year.

Students must take 40 core credit modules (20 per semester) as follows:

PYU11P10	Physics 1	1	10
PYU11P20	Physics 2	2	10
MAU11S01	Mathematics for Scientists 1	1	10
MAU11S02	Mathematics for Scientists 2	2	10

Students will choose Open Modules to the value of 20 credits (10 per semester) from the following:

BYU11101	From Molecules to Cells	1	10
BYU11102	From Organisms to Ecosystems	2	10
CHU11101	General and Physical Chemistry	1	10
CHU11102	Introduction to Inorganic and Organic Chemistry	2	10
GSU11001	Spaceship Earth: Introduction to Earth System Science	1	10
GSU11005	Geology: A Beginner's Guide to Planet Earth	2	10

Note again that only certain patterns of choice of Open Modules are possible, and that the choice of Open modules in the Junior Fresh year then determines the Open Modules that must be taken in the Senior Fresh year. This is fully explained in the following pages.

Physical Sciences Moderatorships

In the Junior and Senior Fresh years TR063 students complete a course of study which will qualify them to compete for places in the following Moderatorships after the Senior Fresh year. The three available Moderatorship choices are:

- Physics - 30 places available
- Physics and Astrophysics - 24 places available
- Nanoscience - 26* places available (*10 from chemical Sciences)

Moderatorship in Physics

In brief, a Moderatorship in **Physics** leads to a recognised Physics degree and encompasses the core physics subjects such as quantum mechanics, mechanics, thermodynamics, electromagnetism, oscillations and waves, condensed matter physics, atomic physics, relativity, nuclear structure, statistical physics, lasers, and optics among others. The broad-based Physics Moderatorship places an equal emphasis on diverse important subjects of nanoscience, magnetism, semiconductor device technology, photonics, nuclear and particle physics, superconductivity as well as aspects of astrophysics. It serves as the ideal launching point for a research or industrial career following any or all these subject areas.

Moderatorship in Physics and Astrophysics

A Moderatorship in **Physics and Astrophysics** leads to a recognised Physics degree and encompasses the core physics subjects such as quantum mechanics, mechanics, thermodynamics, electromagnetism, oscillations and waves, condensed matter physics, atomic physics, relativity, nuclear structure, statistical physics, lasers, and optics among others. The Physics and Astrophysics Moderatorship places astrophysics, stellar physics, stellar and galactic formation, cosmology, and astronomical techniques first and foremost in this degree albeit at the expenses of subjects such as nanoscience, photonics, superconductivity and semiconductor device technology.

Moderatorship in Nanoscience

A Moderatorship in **Nanoscience** leads to a recognised Physics degree and encompasses the core physics subjects such as quantum mechanics, mechanics, thermodynamics, electromagnetism, oscillations and waves, condensed matter physics, atomic physics, relativity, nuclear structure, statistical physics, lasers, and optics among others, as well as a recognisable core of physical, inorganic, organic and materials chemistry. The Nanoscience Moderatorship places the physics and chemistry of modern materials first and foremost which encompasses nanoscience, semiconductors and semiconductor device technology, photonics, materials chemistry, electrochemistry, polymers and photochemistry, all topics relevant to modern materials research, inclusive of energy materials, sensors and of microelectronics and any underpinning nanoscience.

Open Module Choices in Junior and Senior Fresh Years

The following table is indicative of the core modules and available Open modules in both Junior Fresh and Senior Fresh year of the TR063: Physical Sciences degree.

Year 1: JUNIOR FRESH	
CORE MODULES – 40 credits 20/20	
Semester 1	**Semester 2**
PYU11P10 Physics 1	PYU11P20 Physics 2
MAU11S01 Mathematics for Scientists 1	MAU11S02 Mathematics for Scientists 2

Year 2: SENIOR FRESH			
CORE MODULES – 40 credits 20/20			
Semester 1		**Semester 2**	
PYU22P10 Physics 3		PYU22P20 Physics 4	
MAU22S01 Multi-variable calculus	MAU22S03 Fourier Analysis	MAU22S04 Vector Calculus	PIU22292 History, Philosophy and Ethics of Science

OPEN MODULES – choose 20 credits 10/10	
CHU11101 General and Physical Chemistry	CHU11102 Introduction to Inorganic and Organic Chemistry
GSU11001 Spaceship Earth: Introduction to Earth System Science	GSU11005 Geology: A Beginner's Guide to Planet Earth
BYU11101 From Molecules to Cells	BYU11102 Organisms to Ecosystems

OPEN MODULES – choose 20 credits 10/10	
CHU22201 Chemistry 1	CHU22202 Chemistry 2
GSU22201 From Atoms to Rocks: Introduction to Geochemistry	GSU22006 Physical Geography: Dynamic Earth
GSU22205 Sedimentary Processes & Environments in a Changing World	
BYU22201 From Molecules to Cells 2	BYU22202 From Cells to Organisms

Note that there are limitations on Open module choices across the Junior and Senior Fresh years due to prerequisites in the Senior Fresh year that depend upon or require Open modules in the Junior Fresh year. The possible patterns of Open Modules are shown in the diagram on the next page.

Moderatorship and Open Module Choice Diagram

Moderatorships in **Physics** or in **Physics and Astrophysics** are available to all students regardless of the choice of Open modules in the Junior Fresh and Senior Fresh years.
To qualify for the Moderatorship in **Nanoscience**, a student must take all available Chemistry Open modules in both semesters of the Junior and Senior Fresh years.
The following five patterns of Open Modules are available to students across the Junior Fresh and Senior Fresh years. These are denoted A, B, C, D and E and correspond to the indicated patterns on the TR063 Physical Sciences Junior Fresh module choice form.

	Year 1: JUNIOR FRESH		**Year 2: SENIOR FRESH**	
	Semester 1	**Semester 2**	**Semester 1**	**Semester 2**
A	CHU11101 General and Physical Chemistry	CHU11102 Introduction to Inorganic and Organic Chemistry	CHU22201 Chemistry 1	CHU22202 Chemistry 2
	Semester 1	**Semester 2**	**Semester 1**	**Semester 2**
B	CHU11101 General and Physical Chemistry	GSU11005 Geology: A Beginner's Guide to Planet Earth…	GSU22201 From Atoms to Rocks: An Introduction to Geochemistry. GSU22205 Sedimentary Processes & Environments in a Changing World	GSU22006 Physical Geography: Dynamic Earth
	Semester 1	**Semester 2**	**Semester 1**	**Semester 2**
C	GSU11001 Spaceship Earth: Introduction to Earth System Sciences…	GSU11005 Geology: A Beginner's Guide to Planet Earth	GSU22201 From Atoms to Rocks: An Introduction to Geochemistry. GSU22205 Sedimentary Processes & Environments	GSU22006 Physical Geography: Dynamic Earth

Moderatorship

- **Nanoscience** (pattern A)
- **Physics** (patterns A, B, C)
- **Physics & AstroPhysics** (patterns A, B, C)

			in a Changing World	
	Semester 1	**Semester 2**	**Semester 1**	**Semester 2**
D	BYU11101 From Molecules to Cells	BYU11102 Organisms to Ecosystems	BYU22201 From Molecules to Cells 2	BYU22202 From Cells to Organisms
	Semester 1	**Semester 2**	**Semester 1**	**Semester 2**
E	BYU11101 From Molecules to Cells	GSU11005 Geology: A Beginner's Guide to Planet Earth	GSU22201 From Atoms to Rocks: An introduction to Geochemistry. GSU22205 Sedimentary Processes & Environments in a Changing World	GSU22006 Physical Geography: Dynamic Earth

Applications to choose a specific Moderatorship after the Senior Fresh year occur via a preferred Moderatorship choice form that will be available in Semester 2 of the Senior Fresh year. **Note especially that there are quotas and hence competition for in-demand Moderatorships.** Allocation of places in Moderatorships is based on student ranking of final weighted average marks across all Senior Fresh modules for those who complete the Senior Fresh year. All qualified Physical Sciences students will be able to proceed to a Moderatorship.

Semester Structure

TR063: PHYSICAL SCIENCES
CORE MODULES (mandatory) – 20 credits per semester

SEMESTER 1 – Michaelmas term **15th September 2025 – 05th December 2025**	**SEMESTER 2 – Hilary Term** **19th January 2026 - 10th April 2026**
PYU11P10: Physics 1	PYU11P20: Physics 2
MAU11S01: Mathematics 1	MAU11S02: Mathematics 2

OPEN MODULES (optional): Students choose 10 credits from each semester

BYU11101: From Molecules to Cells	BYU11102: Organisms to Ecosystems
CHU11101: General and Physical Chemistry	CHU11102: Introduction to Inorganic and Organic Chemistry
GSU11001: Spaceship Earth: An introduction to Earth System Science	GSU11005: Geology: A Beginner's Guide to Planet Earth

Change of selected Open Modules

If, after a couple of weeks, you feel that you have perhaps made the wrong choice of Open module, **please seek advice immediately** from your Tutor, Course Director, or the Science Course Office. It may be possible for you to change from one module to another within science, subject to permission from the Associate Dean of Undergraduate Science Education. If you do decide to change modules, then do so **quickly** - it can be difficult to try to catch up with work in a new module if you have missed more than two or three weeks of lectures. You should call into the Science Course Office if you wish to change modules.

Note that **no change to your module pattern is at all way possible after Semester 1 or after the completion of your Junior Fresh year**. Your Open modules in the Senior Fresh year are entirely determined by the module pattern that you have started on in the Junior Fresh year. See again the module patterns on the previous page.

TR63 Physical Sciences Core Modules

PYU11P10: Physics 1

Semester 1, 10 credits

The most fundamental foundational aspects of any physics education concern the motion of objects due to forces and how to mathematically describe these motions. Collective motions in response to forces lead to propagating physical waves, where similar mathematics can then describe electromagnetic waves or light. The first semester of your Physical Sciences education has an in-depth study of motion, forces, oscillation, and light as the key physical concepts upon which to build. Of equal importance to the mathematical description of how the world we live in behaves, as described by a physical law, is an ability to make a measurement to verify or otherwise test the action of a physical law. Hence the physics laboratory plays a key role in the Physical Sciences education where the techniques of physical measurements are introduced together with the fundamentals of the experimental method and the manner in which the results of any experiment can be analysed.

Structure and contact hours.

Lectures (4-5 hrs per week); practical laboratory (3hrs per week); online assignments (1 per week), tutorial classes (1 per week after 3rd or 4th week of semester).

Lecture Topics

Introduction to Physics - 1 lectures (E. Keane)
Introduction to the Physics Laboratory (K. Rode)
The Physics of Motion – 20-22 lectures (M. Ferreira)
Waves and Optics I – 18-20 lectures (J. Vos)
Tools for Physics (inc. Statistics) – 14 lectures(D. O'Regan).

Learning outcomes

On successful completion of this module students should be able to:

- Express in mathematical language the motion of a body under the action of forces.
- Describe wave motion and relate it to basic phenomena in light and sound.
- Understand sources of errors in measurements and calculate their propagation.
- Prepare a brief report, which includes an error analysis, of a simple physical experiment.

Syllabus

Introduction to Physics: 1 lecture

An introduction to the School of Physics and the JF Physics course.

The Physics of Motion: 20-22 lectures

Kinematics: velocity, acceleration, representation of motion through graphs, projectile motion, circular motion; Statics: forces, torque, equilibrium; Dynamics: Force-motion relations, Newton's laws, work, energy, linear and angular momenta, impulse, collisions, conservation laws

Waves and Optics I: 18-20 lectures

Resonance, harmonic oscillators, SHM, frequency. Waves: standing, travelling, wavelength, wave velocity. Sound: music, vibrations of a string and of a column of air, harmonics, Doppler Effect. Light: Rayleigh scattering, refraction, reflection, dispersion, index of refraction, polarization, polarized reflection, Malus' law, birefringence, total internal reflection, colour vision, gas discharges, lasers. Optics: refracting optics, lenses, real images, focus, focal length, f-numbers, lens equation, cameras, reflecting optics, curved mirrors, telescopes. Interference: superposition of waves, beating, 2 beam interference, anti-reflection coating. Diffraction: Huygen's principle, diffraction by a slit and grating, X-ray diffraction.

Tools for Physics (inc. Statistics): 14 lectures

Units, orders of magnitude, and dimensional analysis. Essential maths tools for physics. Physical interpretation of differentiation and integration, and differential equations in physics.
Model construction, derivations, and problem solving based on physical principles. Methods for solving equations and interpreting and explaining their results. Methods for approximating equations. Models for physical systems such as pendulum, spring, and capacitor.
Systematic and random errors. Discrete and continuous distributions such as binomial, Poisson,
Gaussian and Lorentzian. Moments of a distribution. Histograms and probability densities. Estimation of mean and standard deviation in a measurement. Error propagation.

Methods of Teaching and Student Learning:

A mixture of lectures, large group tutorials, hands-on laboratory practicals and weekly on-line assignments based on both numerical and conceptual questions from the textbook, as well as online video resources and elective small group tutorials are used in the delivery of this module. The lecture course follows the material in the textbook very closely with reading assignments clearly indicated to students as the lecture course progresses.

The practical sessions are structured to provide an introduction to the process of measurement, estimations of uncertainty (error) and propagation of errors as applied to physics experiments as well as introducing students to programming and data analysis through Python based computational physics experiments. Each experiment has its own specific learning outcomes and is structured to further clarify concepts met in the textbook and lectures thus reinforcing learning.
Weekly homework assignments, typically alternating between topics, are submitted by students through an online system and corrected, with some limited feedback to the student available through the online system post deadline. The lecturer has oversight of the scores and responses to each assignment and can address these in subsequent lectures and tutorials.

Large tutorial groups of the order of 20-30 students meet to discuss with lecturers the solutions to specific assigned physics problems, discussing the approaches, methods, mathematics, and physics of the correct solutions. Video resources comprising short videos on physical intuition, thinking, problem solving or physics approaches as well as some relevant mathematical techniques will be made available online will supplement lecture material and will include some additional short physics topics from your textbooks to illustrate techniques. In addition, students may be invited to attend small group tutorials – in groups of 6-8 – which would meet with assigned academics every second week to introduce and practice the concepts of physics problem solving and the use of mathematics in physics and to develop physics insight in the students. These small group tutorials try to emphasise peer learning within the tutorial format, and these problem-solving activities provide an additional opportunity for the assigned academic to assess understanding and gauge the knowledge level of the students.

Finally, a number of lecturers use class-based polling of student responses to questions using the available "clicker" technologies or poll response technologies in live in-person or live-online lectures.

Methods of Assessment and Weighting

Examination – Written examination paper 60%; Laboratory Practical work 30%; online tutorial homework assignments 10%.

Progression regulations applying to Physics modules and accredited Physics programmes.

An overview of the progression regulations within the Physics programme is detailed here. The full text of these derogations from the College Progression and Award rules can be found at: https://www.tcd.ie/teaching-learning/academic-affairs/ug-prog-award-regs/derogations/by-school.php. Select the year and scroll to the School of Physics.

A) Minimum mark requirement and Qualified Fails in Fresher years

i. These regulations apply to the Fresher JF and SF 10 credit modules that are core to Physical Sciences (TR063) and Theoretical Physics (TR035), and which are available as Open modules to JF and SF Chemical Sciences (TR031) students.
These modules are JF: PYU11P10, PYU11T10, PYU11P20, PYU11T20; and in SF: PYU22P10, PYU22T10, PYU22P20, PYU22T20. *(This does not include PYU11F10, PYU11F20, PYU11H20).*

ii. In these Fresher modules there is a **minimum mark requirement of 30%** separately in both the Examination component and the Laboratory component, in order for either a Pass or a Qualified Pass mark in the module to be granted. The Progression threshold is not simply an overall module mark of 40% or higher but requires minimum marks in these components.

iii. A mark of less than 30% in either the Examination or Laboratory components leads to a Qualified Fail. A Qualified Fail requires reassessment in that component before progression to the next year can occur. Reassessment of the exam component is in the reassessment examination period; reassessment of the laboratory component occurs before the beginning of the reassessment examination period.

iv. If a mark of less than 30% occurs or recurs in the examination or laboratory component following the reassessment period, the student cannot progress and must repeat the year. This necessarily applies to students who had deferred their first attempt at examinations to the reassessment period.

v. Students who fail a module with a module mark of <40%, but >=35% are not eligible for Pass by Compensation, or a Qualified Pass, if either of the examination or laboratory components is less than 30%.

vi. For context only, two points are repeated from the general Undergraduate Progression and Awards regulations. The first is that as many as 10 credits can be eligible for a Qualified Pass or a pass by compensation with marks of 35% or higher, provided the other 50 credits of module marks are 40% or higher, and there is an overall pass. Secondly, students who fail a given module can only be reassessed in the failed components of the module.

B) Capping of reassessed components in the reassessment session in Fresher and Sophister years

- In reassessments, a cap (maximum mark) of 60% will apply to
    - i) all the reassessed components for core Junior Fresh and Senior Fresh Physics modules delivered as part of the Physical Sciences and Theoretical Physics courses (and available to students in the Chemical Sciences course as Open modules) which are listed above in A(i).
    - ii) all reassessed components of all modules in the Sophister years (except Trinity Electives) within the four accredited degree programmes Physics, Physics & Astrophysics, Nanoscience, and Theoretical Physics, irrespective of the owning School. Accreditation of these degree programmes is by the Institute of Physics (IoP).
    - The abovementioned capping will apply to re-assessed components of the affected School of Physics (PYU code) modules irrespective of the degree stream of the student, registration or visiting student status, or year of first admission. The Sophister PYU modules are not available to any other non-accredited Sophister degree programmes.
    - Re-assessment capping does not apply to deferred 1^{st} attempts at assessment.

The capped reassessments are required of College and the School of Physics by the Institute of Physics (IoP) for continued accreditation of our degree programmes in Physics, Physics with Astrophysics, Nanoscience and Theoretical Physics. This was to ensure the continued integrity and quality of our degree programme, results and outcomes. It should be noted that uncapped resits are not the norm in other universities either in Ireland or elsewhere that have degrees accredited by the IoP, where the usual capping level of reassessed components or exams is at 40%. The reassessment capping level agreed with the IoP is a compromise between ensuring the quality of our degree recipients and degree results against the intended purpose of the uncapped resits elsewhere in College. That policy was to encourage students to achieve the intended learning outcomes in the reassessment by engaging fully with learning in order to do their best, and this is still possible as students are rewarded for doing more than the minimum required to pass.

Examples in Junior Fresh or Senior Fresh of Qualified Fails:

- Example of a qualified fail at the first attempt:
  - _Student A in their Semester 1 JF module obtains a mark of 60% in their labs, 80% in their assignments but 25% in their examination with weightings of 30%, 10% and 60% respectively. Their module mark is thus (60*0.3) + (80*0.1) + (25*0.6) = 18+8+15 = 41%. This however is a Qualified Fail as they obtained a mark <30% in their examination. They do not pass the module and must present for reassessment._
  - _Student B in their Semester 2 JF module obtains a mark of 60% in their labs, 80% in their assignments but 20% in their examination with weightings of 30%, 10% and 60% respectively. Their module mark is thus (60*0.3) + (80*0.1) + (20*0.6) = 18+8+12 = 38%. This is a Fail mark in the module, and this mark is not eligible to be a Qualified Pass as this student obtained a mark <30% in their examination. They do not pass the module and must present for reassessment._

    Compensation rules otherwise apply to module marks >=35% provided 50 credits of modules have achieved a pass mark and no more than 10 credits of module are equal to or above 35% and none are below 35%, provided that the annual average mark is 40% or higher.
- Example of a qualified fail at the **second attempt**:
  - _If either Student A or Student B above obtained those marks in their reassessment examination at their second attempt, i.e. obtaining a Qualified Fail or being ineligible for a Qualified Pass, they must repeat the year. Instead of a full repeat year on-books there is the possibility to apply through their Tutor to take the following year as an Off-Books student taking Assessment in this module, if they are eligible to do so._
- Example of a capped reassessment:
  - _Student C in their Semester 2 SF module obtains a mark of 50% in their labs, 80% in their assignments but 20% in their examination with weightings of 30%, 10% and 60% respectively. Their module mark is thus (50*0.3) + (80*0.1) + (20*0.6) = 15+8+12 = 35%. This is a Fail and they are reassessed in the failed component, and not eligible for compensation or a Qualified Pass as they had a mark <30% in their examination._
  - _In their reassessed exam, having engaged at length with the material they perform well in their examination and would obtain a mark of 80%. This exam mark component is capped at 60% while the other component marks remain as they were._
  - _The final mark is thus calculated as: (50*0.3) + (80*0.1) + (**60***0.6) = 15+8+36 = 59% for the module._

Important Note on Examinations, Assessments and Reassessments in Fresher years

- There is a minimum mark requirement of 30% separately in the Examination component and the Laboratory component, in order for a Pass or Qualified Pass mark in the module to be granted. Other components making up fewer marks are not included in this requirement. A mark of less than 30% in either of these Examination or Laboratory components leads to a Qualified Fail and requires reassessment examination or a repeat of the year.
- There is a maximum mark or cap of 60% on any reassessed component in this module if reassessment is required. The final module mark is calculated based on the reassessed component mark and any already achieved marks for components that did not need to be reassessed, according to the published weightings of these components.
- Re-assessment capping does not apply to deferred 1st attempts at assessment.
- These apply to all students in this module.
- For more details please see the section in the School of Physics Undergraduate Handbook on "Progression regulations applying to Physics modules and accredited Physics programmes" available in full at: https://www.tcd.ie/physics/study/current/undergraduate/handbook/ or see a summary at: https://www.tcd.ie/physics/study/current/undergraduate/progression

Reading List:

- University Physics - extended version with Modern Physics, by Hugh D. Young and Roger A. Freedman, Addison-Wesley, 2020, 15th ed.
  Students do NOT buy this book - further information at first lecture of term.
  Students purchase a Mastering Physics subscription with e-text (and optionally physical textbook) via Pearson Learner Store here: Mastering Physics with Pearson eText for University Physics with Modern Physics, Global Edition. Wait until instructed to purchase.

Online Assignments:

Online assignments are submitted through the Mastering Physics system where electronic access is associated with the required/provided textbook.
https://www.masteringphysics.com/site/login.html

Online Resources:

Software used in the practical laboratory – Logger Pro; as well as examples of Python code for analysis of data in the practical laboratory are available through the School of Physics website: https://www.tcd.ie/Physics/study/current/undergraduate/Software-and-online-resources/

Module Website:

Visit http://www.tcd.ie/Physics/study/current/undergraduate for links to all Physics modules and to Blackboard for each module.

Contact Details

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Administrative Officer: Ms. Una Dowling	dowlingu@tcd.ie
	Ph: 01 896 1675

PYU11P20: Physics 2
Semester 2, 10 credits

The motion and response of electrons due to electric and magnetic forces and the energies of electrons in atoms, molecules or metals, determine almost all our interactions with our surroundings. The technological era is predicated on the motion of free electrons in electrical circuits, the coupling of motion to electric current and vice versa via magnetic interactions. The behaviour of electrons in atoms, molecules, metals, and semiconductors is described by quantum theory, which also describes electrons participating in the interaction of light and matter. An introduction to quantum physics and quantum mechanics of light and electrons in atoms is the next foundational aspect of any physics education. It is the heart of the second semester of your Physical Sciences education. Finally, our understanding and ability to observe the universe around us is through the interaction of light and matter, with the structure of the universe governed by the interaction of matter with matter. Gravitational and rotational dynamics determine the structure of the solar system and of the universe, and our knowledge of the universe is through the light we observe across all energy ranges. This is the last of the topics introduced in this first year of your education in the Physical Sciences. The physics laboratory continues in its key role in the Physical Sciences education with further training in experimental methods, analysis techniques and refining of your ability to describe the outcomes of an experiment.

Structure and contact hours:

Lectures (4-5 hrs per week); practical laboratory (3hrs per week); online assignments (1 per week), tutorial classes (1 per week after the 3rd week of the semester).

Lecture Topics:

- Electricity and Magnetism - 20 lectures (A. Lunghi)
- Materials Physics - 16 lectures (L. Jones)
- Gravitation and Astrophysics - 12 lectures (E. Keane)

Learning Outcomes:

On successful completion of this module, students should be able to:

- Solve steady state time-varying electric current and electric potential problems.
- • Solve electrostatic problems using Gaussian Surfaces
- • Describe elementary crystal structures and the response of materials to external forces
- • Describe how the laws of thermodynamics react to properties of matter
- • Develop the ideas of Newton's Law of Gravitation, and the motion of planets and satellites.
- • Describe the main properties of planets, exoplanets, the Sun, and stars.

Syllabus:

Electricity and Magnetism I: 20 lectures

Electrostatics: electric charge, Coulomb's law, electric field, electric dipoles, Gauss's law, electric potential energy, voltage, electric polarisation, capacitance, dielectrics, Electric current, resistance, Ohm's law, electromotive force, power in electric circuits, Kirchoff's laws, RC circuits. Magnetism, magnetic field lines, and flux; Lorentz force on moving charge; Energy of and torque on a current loop in a magnetic field; Biot-Savart Law illustrated by magnetic fields of a straight wire and circular loop; forces between current-carrying straight wires; Ampere's Law in integral form.

• Materials Physics: - 16 lectures

Inter and intra-molecular forces, potential energy curves, translational, rotational and vibrational degrees of freedom, heat capacity, thermal expansion and thermal conductivity. Stress, strain, shear, elastic and plastic deformations of solids, bulk and elastic moduli. Structures of solids in crystalline, glass, plastic phases. Insulators, conductors and semiconductors. Point defects and imperfections in solids – Iron/Carbon system. Density, pressure, surface tension, buoyancy and hydrodynamic-incompressible and compressible flows in fluids. Bernoulli's equation. Viscosity, diffusion, laminar and turbulent flow. Gas laws, kinetic theory and collisions, PVT diagrams, thermal expansion, surface tension. Conductive, convective and radiative transport of heat. Stefan-Boltzmann law.

Gravitation and Astrophysics: 14 lectures

Basic Astrophysical concepts: scale of the universe, our movement through space, celestial sphere and constellations. Motion of the planets: Newton's law of gravitation, gravitational potential energy, motion of satellites, Kepler's laws and the motion of planets, apparent weight and the earth's rotation, escape velocity. Our solar system - the planets: physical properties, composition, terrestrial planets, gas giants. Exoplanets and life in the Universe: planet formation, exoplanets detection and statistics, life in the universe. Stars: the electromagnetic spectrum, physical properties of the Sun and stars, Blackbody radiation, Wien's law, Stefan-Boltzmann law, introduction to the Hertzsprung-Russell Diagram. Binary stars: Doppler effect in astronomy, stellar masses, mass-luminosity-radius relationships. Telescopes: light-collecting power, angular resolution, telescope designs, types of observations.

Method of Assessment and Weighting:

Examination – Written examination paper 60%; Laboratory Practical work 30%; online tutorial homework assignments 10%.

Progression regulations applying to Physics modules and accredited Physics programmes.

An overview of the progression regulations within the Physics programme are detailed here.

The full text of these derogations from the College Progression and Award rules can be found at: https://www.tcd.ie/teaching-learning/academic-affairs/ug-prog-award-regs/derogations/by-school.php Select the year and scroll to the School of Physics.

A) Minimum mark requirement and Qualified Fails in Fresher years

vii. These regulations apply to the Fresher JF and SF 10 credit modules that are core to Physical Sciences (TR063) and Theoretical Physics (TR035), and which are available as Open modules to JF and SF Chemical Sciences (TR031) students.
These modules are JF: PYU11P10, PYU11T10, PYU11P20, PYU11T20; and in SF: PYU22P10, PYU22T10, PYU22P20, PYU22T20. *(This does not include PYU11F10, PYU11F20, PYU11H20).*

viii. In these Fresher modules there is a **minimum mark requirement of 30%** separately in both the Examination component and the Laboratory component, in order for either a Pass or a Qualified Pass mark in the module to be granted. The Progression threshold is not simply an overall module mark of 40% or higher but requires minimum marks in these components.

ix. A mark of less than 30% in either the Examination or Laboratory components leads to a Qualified Fail. A Qualified Fail requires reassessment in that component before progression to the next year can occur. Reassessment of the exam component is in the reassessment examination period; reassessment of the laboratory component occurs before the beginning of the reassessment examination period.

x. If a mark of less than 30% occurs or recurs in the examination or laboratory component following the reassessment period, the student cannot progress and must repeat the year. This necessarily applies to students who had deferred their first attempt at examinations to the reassessment period.

xi. Students who fail a module with a module mark of <40%, but >=35% are not eligible for Pass by Compensation, or a Qualified Pass, if either of the examination or laboratory components is less than 30%.

xii. For context only, two points are repeated from the general Undergraduate Progression and Awards regulations. The first is that as much as 10 credits can be eligible for a Qualified Pass or a pass by compensation with marks of 35% or higher, provided the other 50 credits of module marks are 40% or higher, and there is an overall pass. Secondly, students who fail a given module can only be reassessed in failed components of the module.

B) Capping of reassessed components in the reassessment session in Fresher and Sophister years

- In reassessments, a cap (maximum mark) of 60% will apply to
  - i) all the reassessed components for core Junior Fresh and Senior Fresh Physics modules delivered as part of the Physical Sciences and Theoretical Physics courses (and available to students in the Chemical Sciences course as Open modules) which are listed above in A(i).
  - ii) all reassessed components of all modules in the Sophister years (except Trinity Electives) within the four accredited degree programmes Physics, Physics & Astrophysics, Nanoscience, and Theoretical Physics, irrespective of the owning School. Accreditation of these degree programmes is by the Institute of Physics (IoP).

- The abovementioned capping will apply to re-assessed components of the affected School of Physics (PYU code) modules irrespective of the degree stream of the student, registration or visiting student status, or year of first admission. The Sophister PYU modules are not available to any other non-accredited Sophister degree programmes.
- Re-assessment capping does not apply to deferred 1st attempts at assessment.

The capped reassessments are required of College and the School of Physics by the Institute of Physics (IoP) for continued accreditation of our degree programmes in Physics, Physics with Astrophysics, Nanoscience and Theoretical Physics. This was to ensure the continued integrity and quality of our degree programme, results and outcomes. It should be noted that uncapped resits are not the norm in other universities either in Ireland or elsewhere that have degrees accredited by the IoP, where the usual capping level of reassessed components or exams is at 40%. The reassessment capping level agreed with the IoP is a compromise between ensuring the quality of our degree recipients and degree results against the intended purpose of the uncapped resits elsewhere in College. That policy was to encourage students to achieve the intended learning outcomes in the reassessment by engaging fully with learning to do their best, and this is still possible as students are rewarded for doing more than the minimum required to pass.

Examples in Junior Fresh or Senior Fresh of Qualified Fails:

- Example of a qualified fail at the first attempt:
    - *Student A in their Semester 1 JF module obtains a mark of 60% in their labs, 80% in their assignments but 25% in their examination with weightings of 30%, 10% and 60% respectively. Their module mark is thus (60*0.3) + (80*0.1) + (25*0.6) = 18+8+15 = 41%. This however is a Qualified Fail as they obtained a mark <30% in their examination. They do not pass the module and must present for reassessment.*
    - *Student B in their Semester 2 JF module obtains a mark of 60% in their labs, 80% in their assignments but 20% in their examination with weightings of 30%, 10% and 60% respectively. Their module mark is thus (60*0.3) + (80*0.1) + (20*0.6) = 18+8+12 = 38%. This is a Fail mark in the module, and this mark is not eligible to be a Qualified Pass as this student obtained a mark <30% in their examination. They do not pass the module and must present for reassessment.*

      Compensation rules otherwise apply to module marks >=35% provided 50 credits of modules have achieved a pass mark and no more than 10 credits of module are equal to or above 35% and none are below 35%, provided that the annual average mark is 40% or higher.
- Example of a qualified fail at the **second attempt**:
    - *If either Student A or Student B above obtained those marks in their reassessment examination at their second attempt, i.e. obtaining a Qualified Fail or being ineligible for a Qualified Pass, they must repeat the year. Instead of a full repeat year on-books there is the possibility to apply through their*

Tutor to take the following year as an Off-Books student taking Assessment in this module, if they are eligible to do so.

- Example of a capped reassessment:
  - *Student C in their Semester 2 SF module obtains a mark of 50% in their labs, 80% in their assignments but 20% in their examination with weightings of 30%, 10% and 60% respectively. Their module mark is thus (50*0.3) + (80*0.1) + (20*0.6) = 15+8+12 = 35%. This is a Fail and they are reassessed in the failed component, and not eligible for compensation or a Qualified Pass as they had a mark <30% in their examination.*
  - *In their reassessed exam, having engaged at length with the material they perform well in their examination and would obtain a mark of 80%. This exam mark component is capped at 60% while the other component marks remain as they were.*
  - *The final mark is thus calculated as: (50*0.3) + (80*0.1) + (**60***0.6) = 15+8+36 = 59% for the module.*

Important Note on Examinations, Assessments, and Reassessments in Freshers' years

- There is a minimum mark requirement of 30% separately in the Examination component and the Laboratory component, in order for a Pass or Qualified Pass mark in the module to be granted. Other components making up fewer marks are not included in this requirement. A mark of less than 30% in either of these Examination or Laboratory components leads to a Qualified Fail and requires reassessment examination or a repeat of the year.
- There is a maximum mark or cap of 60% on any reassessed component in this module if reassessment is required. The final module mark is calculated based on the reassessed component mark and any already achieved marks for components that did not need to be reassessed, according to the published weightings of these components.
- Re-assessment capping does not apply to deferred 1st attempts at assessment.
- These apply to all students in this module.
- For more details, please see the section in the School of Physics Undergraduate Handbook on “Progression regulations applying to Physics modules and accredited Physics programmes” available in full at: https://www.tcd.ie/physics/study/current/undergraduate/handbook/ or see a summary at: https://www.tcd.ie/physics/study/current/undergraduate/progression

Reading List

- University Physics - extended version with Modern Physics, by Hugh D. Young and Roger A. Freedman, Addison-Wesley, 2020, 15th ed.
  Students do NOT buy this book - further information at the first lecture of the term.
  Students purchase a Mastering Physics subscription with e-text (and optionally physical textbook) via Pearson Learner Store here: Mastering Physics with Pearson eText for

University Physics with Modern Physics, Global Edition. Wait until instructed to purchase.

Online assignments:

Online assignments are submitted through the Mastering Physics system where electronic access is associated with the required/provided textbook.
https://www.masteringphysics.com/site/login.html

Online Resources:

Software used in the practical laboratory – Logger Pro; as well as examples of Python code for analysis of data in the practical laboratory are available through the School of Physics website: https://www.tcd.ie/Physics/study/current/undergraduate/Software-and-online-resources/

Module website:

Visit http://www.tcd.ie/Physics/study/current/undergraduate for links to all Physics modules and to Blackboard for each module.

PYU11P10 and PYU11P20: Physics 1 and Physics 2 Laboratory Practical - CORE

Summary of Laboratory Practical

Across Physics 1 and Physics 2 modules students complete 2 computational physics experiments (using Python) and as many as 16 out of 20 available bench experiments for a total of 18 experiments performed by the student in the academic year. Many of the laboratory experiments are available on the bench in both semesters and thus the progress of students through the experiments differs from student to student with the exception of the computational physics experiments which all students complete. Students are required to record all data and information related to experiments in a hardback practical laboratory notebook which is assessed. A proportion of these experiments may be virtual experiments performed or data analysed at home in the academic year 2022/2023, either singly or with virtual partners, possibly augmented by at-home experimental measurements.

Laboratory Practical:

Introduction to Python
Python lab 1: Monte Carlo Approximation
Python lab 2: The Trajectory of a Projectile with Friction
Experiment 1: The Pendulum
Experiment 2: Energy Conservation
Experiment 3: Thin Lenses
Experiment 4: Density and the Principle of Archimedes
Experiment 5: Surface Tension
Experiment 6: Electrical Resistance
Experiment 7: DC Circuits
Experiment 8: Charging/Discharging a Capacitor
Experiment 9: Collisions and Momentum Transfer
Experiment 10: The Resonance Tube
Experiment 11: Leslie's Cube
Experiment 12: Faraday's Law
Experiment 13: Aperture and Depth of Field
Experiment 14: Interference and Diffraction
Experiment 15: The Geiger Counter
Experiment 16: Centripetal Acceleration
Experiment 17: The Photoelectric Effect
Experiment 18: The Bandgap of Germanium
Experiment 19: The Spectrometer
Experiment 20: AC circuits

Online Resources:

Software used in the practical laboratory – Logger Pro; as well as examples of Python code for analysis of data in the practical laboratory are available through the School of Physics website: https://www.tcd.ie/Physics/study/current/undergraduate/Software-and-online-resources/

Assessment of the laboratory

Half of a student's experiments are assessed through an at-the-bench laboratory notebook assessment – the rest of the student's experiments are assessed through written reports of the experiment. In all experiments both the laboratory notebook and the submitted experimental reports must include and require a complete data analysis, error estimation and statistical analysis and description and concise report of the outcomes of the experiment, and any inferences or conclusions that can be drawn from the outcome. A similar assessment requirement applies to the python based computational physics experiments, with the addition of assessment of the code used by the student. As a proportion of these experiments may be virtual experiments performed at home, some assessments may then also take place in a virtual interview, instead of at-bench interviews.

Contact Details:

Physics Undergraduate Laboratory Coordinator: Dr. Karsten Rode	RodeK@tcd.ie Ph: 01 896 3649
Junior Fresh Physics Coordinator: Professor Evan Keane	Evan.Keane@tcd.ie
Administrative Officer: Ms. Una Dowling	dowlingu@tcd.ie Ph: 01 896 1675

MAU11S01: Mathematics for Scientists 1

Semester 1, 10 credits

Contact hours:

11 weeks of teaching with 6 lectures and 2 tutorials per week

Learning outcomes:

On successful completion of this module, students will be able to

- Explain basic ideas relating to functions of a single variable and their graphs, such as limits, continuity, invertibility and differentiability.
- State basic properties and compute limits, derivatives, and integrals for a wide range of functions, including rational and transcendental functions.
- Use derivatives to find the minimum and maximum values of a function of one real variable.
- Use various techniques of integration to compute definite and indefinite integrals.
- Apply techniques from calculus to a variety of applied problems.
- Manipulate vectors to perform algebraic operations such as dot products and orthogonal projections and apply vector concepts to manipulate lines and planes in Rn.
- Use Gaussian elimination techniques to solve systems of linear equations, find inverses of matrices, and solve problems that can be reduced to systems of linear equations.
- Manipulate matrices algebraically and use concepts related to matrices such as invertibility, symmetry, triangularity, and nilpotence.
- Manipulate numbers in different number systems.

Module content:

- **Calculus part:** functions, limits and continuity, derivatives, graphs of functions, optimisation problems, integration, exponential functions, logarithmic functions, inverse trigonometric functions.
- **Discrete part:** vectors, dot product, system of linear equations, Gauss-Jordan elimination, inverse matrix, diagonal and triangular matrices, symmetric matrices, number systems.

Recommended reading list:

- *Calculus: Late Transcendentals* by Anton, Bivens, and Davis.
- *Elementary linear algebra* by Anton and Rorres.

Assessment details:

- This module is examined in a 3-hour examination at the end of Semester 1.
- Continuous assessment contributes 20% towards the overall mark.
- The module is passed if the overall mark for the module is 40% or more. If the overall mark for the module is less than 40% and there is no possibility of compensation, the module will be reassessed as follows:
  1) A failed exam in combination with a passed continuous assessment will be reassessed by an exam in the supplemental session.

2) The combination of a failed exam and a failed continuous assessment is reassessed by the supplemental exam.
3) A failed continuous assessment in combination with a passed exam will be reassessed by one or more summer assignments in advance of the supplemental session.

Contact Details:

Module Coordinator: Dr. Chaolun Wu	chaolunwu@maths.tcd.ie
Dr. Nicolas Aidoo	naidoo@tcd.ie
General enquiries:	mathdep@maths.tcd.ie Phone: 01 896 1949

MAU11S02: Mathematics for Scientists 2

Semester 2, 10 credits

Contact hours:

11 weeks, 6 lectures + 2 tutorials per week

Learning outcomes:

On successful completion of this module students will be able to:

- Use standard techniques to compute definite integrals.
- Use integrals to compute volumes, areas and lengths.
- Evaluate improper integrals.
- Formulate and solve first-order differential equations.
- Determine whether a given sequence converges or not.
- Test a given series for convergence.
- Approximate a given function by polynomials using Taylor and Maclaurin series.
- Compute determinants using either cofactor expansion or upper triangular forms.
- Use Cramer's rule to solve linear equations.
- Use the adjoint matrix to invert matrices.
- Construct bases for the row space, column space and nullspace of a matrix.
- Construct orthonormal bases in three dimensions.
- Calculate the matrices of various linear maps.
- Compute linear and quadratic curves matching data using the least squared error criterion.
- Calculate eigenvalues and eigenvectors for 2x2 matrices, with applications to differential equations.
- Derive probability distributions in some simple cases.
- Solve problems involving the binomial distribution.
- Calculate percentage points for continuous distributions such as the normal, chi-squared, and student's t-distribution.
- Compute confidence intervals for the mean and standard deviation.

Module content:

- Applications of integrals: area between curves, volume of a solid, length of a plane curve, area of a surface of revolution.
- Techniques of integration: integration by parts, trigonometric substitutions, numerical integration, improper integrals.
- Differential equations: separable, first-order linear, Euler method.
- Infinite series: convergence of sequences, sums of infinite series, tests for convergence, absolute convergence, Taylor series.
- Parametric curves and polar coordinates.
- Determinants, Cramer's rule, inverting matrices using cofactors.
- Vector spaces, bases.
- Row space, column space and nullspace of a matrix.
- Orthogonal and orthonormal bases in two and three dimensions.

- Matrices of linear transformations.
- Eigenvalues and eigenvectors for 2x2 matrices, matrix exponentials, systems of linear differential equations.
- Least squares approximations, straight lines, quadratic curves.
- Probability distributions: uniform, binomial, Poisson, normal.
- Central limit theorem.
- Confidence intervals, z-intervals, t-intervals.
- Hypothesis testing, confidence intervals for the mean and standard deviation.

Recommended reading lists:

- *Calculus: Late transcendentals* by Anton, Bivens and Davis.
- *Elementary linear algebra* by Anton and Rorres (not necessary, only for extra reading)
- *Linear algebra an its applications by David Lay* (not necessary, only for extra reading)
- *Biocalculus: Calculus, Probability and Statistics for the life sciences by James Stewart and Troy Davis* (not necessary, only for extra reading)

Module Prerequisite:

MAU1S001 Mathematics for Scientists 1 (First Semester)

Assessment details:

- This module is examined in a 3-hour examination at the end of Semester 1.
- Continuous assessment contributes 20% towards the overall mark.
- The module is passed if the overall mark for the module is 40% or more. If the overall mark for the module is less than 40% and there is no possibility of compensation, the module will be reassessed as follows:
  1) A failed exam in combination with a passed continuous assessment will be reassessed by an exam in the supplemental session.
  2) The combination of a failed exam and a failed continuous assessment is reassessed by the supplemental exam.
  3) A failed continuous assessment in combination with a passed exam will be reassessed by one or more summer assignments in advance of the supplemental session.

Contact Details:

Module Coordinators for MAU11S02: Professor Miriam Logan	E-mail: loganmi@tcd.ie
Professor Anthony Brown	E-mail: browna2@tcd.ie
General inquiries:	E-mail: mathdep@maths.tcd.ie

TR063 Physical Sciences Open Modules

BYU11101: From Molecules to Cells I

Semester 1, 10 credits
Module Coordinator: Kevin Mitchell Email: kevin.mitchell@tcd.ie

Module Learning Aims

This module aims to introduce students to molecular and cellular biology, including key topics in Cell Biology, Biochemistry, Genetics, and Microbiology. A description of the possible origin of life, from the abiotic world to single-celled and multicellular organisms is given, and the ultrastructure of the prokaryotic and eukaryotic cells is covered in detail. The properties and functions of the major classes of biochemicals found in living systems (carbohydrates, lipids, proteins, and nucleic acids) are described, the structure and function of membranes and organelles, and the chemical basis of metabolism and energy transfer in the cell. Students are introduced to basic concepts in Genetics, how the information contained in DNA (genes) is expressed, replicated, and inherited. Finally, the sheer diversity of life forms, from viruses to prokaryotic and eukaryotic microorganisms, to more complex plant and animal life forms is described. Students also study cell and virus structure, cell growth and viral replication, agents of infectious diseases, and host immunity.

Learning Outcomes

On successful completion of the module, students will be able to:
Provide an account of the cellular basis of life: from its origins in the abiotic world, to the evolution of unicellular and multicellular organisms.
Describe the diversity of life forms: including viruses, prokaryotes (bacteria), archaea, and eukaryotes (unicellular organisms, animals, and plants).
Provide an account of the chemical basis of life and the biochemistry on which living systems depend: the properties and functions of the major classes of biomolecules, the structure and function of membranes and organelles, and the chemical basis of metabolism and energy transfer.
Describe how the information contained in DNA (genes) directs the construction and growth of an organism, and how this information is replicated and transmitted from one generation to the next (inheritance; genetics).
Employ a range of laboratory techniques, demonstrating the development of practical scientific skills, knowledge of experimental design and the interpretation of results.
Apply the scientific method as a fundamental approach to experiment-based investigations, critical analysis of data, and problem solving.

Contact Hours/Methods of Teaching and Learning

Lectures and practical's will be supplemented with information sessions, tutorials and activities that provide guidance in the use of library resources, laboratory health and safety, writing techniques, help with avoiding plagiarism and examination techniques. Sixty-five hours contact time.

Module Content

Lecture Topic	Lecturer	Practicals
Introduction to Module	Kevin Mitchell	
Section 1: Origin of Life – Cellular basis of life – Diversity of Life Forms		
Lecture 1: Cellular basis of life 1	Prof. Luke O'Neill	The Diversity of Life Forms
Lecture 2: Cellular basis of life 2	Prof. Luke O'Neill	
Lecture 3: Cellular basis of life 3	Prof. Luke O'Neill	Liquid Handling
Lecture 4: Origin of life 1	Prof. Luke O'Neill	
Lecture 5: Origin of life 2	Prof. Luke O'Neill	Bacterial Growth & Survival
Lecture 6: The Tree of Life	Prof. Alastair Fleming	
Lecture 7: Bacteria	Prof. Alastair Fleming	
Lecture 8: The Archea	Prof. Alastair Fleming	
Lecture 9: Fungi & Protists	Prof. Alastair Fleming	
Lecture 10: Viruses	Prof. Alastair Fleming	
Lecture 11: Interplay between microbes	Prof. Alastair Fleming	
Section 2: The Chemistry of Life		
Lecture 12: Introduction to Biochemistry	Prof. Ken Mok	
Lecture 13: Nucleotides, amino acids & peptides	Prof. Ken Mok	Enzyme Purification (Chromatography)
Lecture 14: Proteins & protein structure	Prof. Ken Mok	
Lecture 15: Protein function	Prof. Ken Mok	
Lecture 16: Enzymes: the catalysts of life 1	Prof. Vincent Kelly	
Lecture 17: Enzymes: the catalysts of life 2	Prof. Vincent Kelly	Enzyme Characterisation (Kinetics)
Lecture 18: Lipids & membranes	Prof. Vincent Kelly	
Lecture 19: Metabolism & major metabolic pathways 1	Prof. Vincent Kelly	
Lecture 20: Metabolism & major metabolic pathways 2	Prof. Vincent Kelly	
Lecture 21: Mitochondria & respiration	Prof. Vincent Kelly	
Lecture 22: Chloroplasts & photosynthesis	Prof. Vincent Kelly	
Section 3 Biological Information – Genetics, Heredity & DNA		
Lecture 23: Introduction to Genetics	Prof. Matt Campbell	Mendelian Genetics
Lecture 24: Mendelian Genetics	Prof. Matt Campbell	
Lecture 25: Linkage & recombination 1	Prof. Matt Campbell	
Lecture 26: Identification of DNA as hereditary material	Prof. Matt Campbell	
Lecture 27: Quantitative genetics	Prof. Matt Campbell	
Lecture 28: DNA - structure & function	Prof Kevin Mitchell	
Lecture 29: Information flow in the cell - the Central Dogma 1	Prof Kevin Mitchell	

Lecture 30: Information flow in the cell - the Central Dogma 2	Prof Kevin Mitchell	
Lecture 31: Mutation & its consequences	Prof Kevin Mitchell	
Module overview and exam prep	Prof Kevin Mitchell	

Lecture Content:

- **Origin of Life:** What is Life? How did it arise? The Origin of Life from a chemical and cellular perspective; the abiotic world; the prebiotic world; Miller-Urey experiment; the first cell; photosynthesis and oxygen – mass extinction; origin of first eukaryotic cell; multicellular life; cell specialization.
- **Cellular basis of life:** Cell structure – prokaryotes, archaea, eukaryotes - animal and plant
- organelles & their prokaryotic origin – mitochondria, chloroplasts, mitosis, and meiosis – cell division – regulation of cell division.
- **Diversity of Microbial Life:** the tree of life; bacteria, archaea, fungi & protists, cell structure, morphology, function, and habitat; extremophiles; viruses
- **Relationship between life forms**: the good, the bad and the ugly; concepts of symbiosis and parasites; plant and animal diseases.
- **Structural principles for small molecules:** elements and chemical groups in life, bonds, bond energies, bond lengths; forces between biological molecules and chemical groups; asymmetry; four classes of biomolecules: amino acids, nucleotides, carbohydrates & lipids
- **Nucleotides, Amino acids and peptides**: DNA, RNA, chromatin and chromosome structure, properties of amino acids, chemical features, and physical properties of the R-groups; the peptide unit and peptide bond
- **Proteins and protein structure:** the concept that shape dictates function; hierarchical organization of protein structure; concept of primary, secondary, tertiary and quaternary structure; introduction to forces that stabilize protein structure.
- **Protein function**: functional classes of protein; introduction to bioinformatics; proteins and evolution; relationships between proteins; similarity and identity.
- **Enzymes:** structure & function; reaction mechanisms; co-factors and vitamins; kinetics; regulation of enzyme activity
- **Lipids and membranes:** lipid structures, fatty acids, phospholipids; membranes, chemical and physical properties, membrane proteins; transport across membranes; concept of compartmentation and membrane traffic.
- **Metabolism & major metabolic pathways:** the starting point: introduction to carbohydrates and fatty acids; organization, energetic principles, key steps, and links between the main metabolic pathways; glycolysis, TCA cycle, beta oxidation; outline of the reversing catabolic pathways, gluconeogenesis, and fatty acids synthesis.
- **Mitochondria & Respiration:** mitochondria, redox reactions, and energy transduction; electron transport and the electron transport chain; oxidative

phosphorylation; coupling of oxidations to phosphorylation; chemiosmotic view of energy transduction (in brief).

- **Chloroplasts and Photosynthesis: c**hloroplast, architecture and function, overview of the light and dark reactions of photosynthesis.
- **Introduction to Genetics:** an outline of some core concepts from classical genetics to the present; a whistle stops tour of key discoveries in the history of genetics.
- **Mendelian Genetics**: Mendel's laws, the 1st law of segregation and the 2nd law of independent assortment using monohybrid and dihybrid crosses; concepts relating to genetic analysis and the use of model systems; inheritance patterns for single gene disorders - pedigree analysis.
- **Linkage and recombination:** Meiosis and the role of 'crossing over' in gene mapping; a brief recap regarding Mendelian genetics – for example, highlighting that genetic linkage breaks Mendel's 2nd law of independent assortment; outline of key concepts underlying the generation of genetic maps; classical work by Sturtevant / Morgan.
- **Identification of DNA as hereditary material;** key experiments establishing DNA as the genetic material; bacterial transformation and its significance (Griffith / Avery, McLeod & McCarthy / Hershey-Chase); the concept of horizontal gene transfer (mechanisms transformation, conjugation, transduction); differences in vertical and horizontal gene transfer.
- **Quantitative Genetics:** an overview of concepts relating to discrete variation versus continuous variation; experiments demonstrating that quantitative traits are inherited, examples of quantitative traits in humans; concepts regarding the use of GWAS to elucidate the genetics architecture of complex traits using an example of one or more disorders.
- **DNA, Structure and Function:** the double helix - discovery of the structure of DNA – DNA composition - DNA replication – semi-conservative replication, replication forks, leading and lagging strand synthesis, DNA polymerases; DNA replication in prokaryotes and eukaryotes.
- **Information flow in the cell - The Central Dogma:** transcription, RNA polymerases in prokaryotes and eukaryotes; promoters, repressors, terminators – the *lac* operon; transcription factors, enhancers; decoding the information in mRNA, translation; ribosomes in prokaryotes and eukaryotes, tRNAs and aminoacyl tRNA synthetases, the genetic code; introduction to the regulation of gene expression – positive and negative regulation.
- **DNA –Mutation and its consequences:** mechanisms by which mutations are generated - including errors in DNA replication; the action of chemical and physical mutagens; errors in chromosome construction and distribution; an outline of the different types of mutation (missense, nonsense, frameshift mutations) and their molecular consequences in relation to gene expression and protein function; mutations causing inherited diseases and cancer; DNA repair – mechanisms of DNA repair, repair deficiency and disease.

Recommended Textbook

Campbell Biology, 12th Edition By Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece (Published by Pearson (2021)

Assessment Details:

1. (A) **End of semester examination: 50% of module mark**. The exam format will be closed-book, in-person, with fifty multiple-choice questions drawn from across the lecture course, 2 hours allowed, negative marking (-0.1) will apply.

2. **Coursework: 50% of module mark.** Coursework includes compulsory attendance at laboratory sessions, assignments associated with practical's, in-course essay and MCQ tests of lecture material. Marks breakdown across the various components will be published in Blackboard.

Further Information

Plagiarism

Students should note that College penalties for plagiarism apply to both examinations and continuous assessment.

Late work

A penalty of 10% deduction in the final mark for every week or part of a week late.

Missed classes/assessments

The attendance at all scheduled classes for this module is compulsory. A student who is unable to attend a class for any reason must notify the science course office here of the reason for absence without delay, and present certification as appropriate.

Non-satisfactory reports

Students who have not fulfilled the module requirements with regard to attendance and/or coursework may be reported to the Senior Lecturer as non-satisfactory for one or more terms. Students reported as non-satisfactory for the Michaelmas and Hilary terms may be refused permission to take their formal University assessment sessions and may be required by the Senior Lecturer to repeat the year.

Compensation

Students must obtain an overall module mark of 40% to pass the module.

Contact Details:

Module Coordinator: Kevin Mitchell kevin.mitchell@tcd.ie
Biology Course Coordinator: Mirela Dardac mdardac@tcd.ie
Phone: 01 8962895

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BYU11102: Organisms to Ecosystems I

Semester 2, 10 credits

Module Coordinator: Trevor Hodkinson hodkinst@tcd.ie

Module learning aims

Organisms to Ecosystems I aims to introduce students to the biology of individuals, species, populations, and ecosystems, and explore how humans interact with other living organisms. It covers the developmental biology of organisms, their physiology, brain function and the evolutionary and ecological responses of organisms to their environment. Topics incorporate the diversity of life and its biological development, interactions between organisms and their environment, the biological context of climate change, human impacts on the environment, future food sustainability, urban ecology, ecosystem services and the value and conservation of biodiversity. Topics are arranged in three sections: 1) Multicellularity and Development, Physiology, Behavior and Neuroscience, 2) Evolution: Adaptation, Populations and Biodiversity, and 3) Ecology and Environment.
A mixture of lectures, tutorials and hands-on laboratory practicals are used in the delivery of this module. There will be one - ecology practical - on a field site outside of campus.

Learning outcomes

On successful completion of this module, the student will be able to:

1. Outline the major steps involved in how complex animal and plants are formed and be able to relate the morphological changes that occur to the molecular and cellular changes that underlie and drive embryo and organ development.
2. Describe the concept of homeostasis at the cell, organ, and organism level; give examples of the functional interrelationships that exist between cells, organs, and systems; provide an account of how organisms can sense change in the environment.
3. Describe the basic principles by which the brain functions and outline key experimental steps and informative clinical cases that have elucidated our current understanding of brain function.
4. Recognize the diversity of life on earth and describe how it evolved over geological time scales.
5. Describe the ecological relationships between individuals, populations, communities, and ecosystems, and between organisms and their environment.
6. Recognize how humans can positively and negatively influence other living organisms and their environment and understand the value of other living organisms for humans.
7. Demonstrate practical, numerical, and analytical skills.
8. Collate, synthesize, organize, and present information in written reports.

Contact Hours/Methods of Teaching and Learning

Lectures and practical's will be supported by online resources provided in Blackboard. Essay writing skills will be developed. 65 hours of contact time.

Module Content

Lecture Topic	Lecturer	Practicals
Lecture 1: Introduction, objectives and overview	Prof. Trevor Hodkinson	
Section 1 Multicellularity and Development, Physiology, Behaviour and Neuroscience		
Lecture 2: Multicellularity and principles of development.	Prof. Rebecca Rolfe	
Lecture 3: The first steps in building a new organism and how we study development	Prof. Rebecca Rolfe	Development and Floral Morphology
Lecture 4: Building a new organism: establishment of a body plan	Prof. Rebecca Rolfe	
Lecture 5: Cellular differentiation and regulation of gene expression	Prof. Rebecca Rolfe	
Lecture 6: Morphogenesis: generation of structure and form	Prof. Rebecca Rolfe	Physiology
Lecture 7: Form and function	Prof. Áine Kelly	
Lecture 8: Homeostasis	Prof. Áine Kelly	
Lecture 9: Physiological regulation of function	Prof. Áine Kelly	
Lecture 10: Pre-neuroscience history of mind/brain ideas	Prof. Tomas Ryan	
Lecture 11: Fundamentals of nervous system structure and function	Prof. Tomas Ryan	
Lecture 12: Introduction to the biology of memory storage	Prof. Tomas Ryan	
Section 2 Evolution: Adaptation, Populations and Biodiversity		
Lecture 13: Short history of life	Prof. Trevor Hodkinson	First Life
Lecture 14: Fossils, global change and extinctions	Prof. Trevor Hodkinson	
Lecture 15: Selection and the modern synthesis	Prof. Trevor Hodkinson	Diversity of Life
Lecture 16: Species and speciation	Prof. Trevor Hodkinson	
Lecture 17: Speciation	Prof. Trevor Hodkinson	Evolution
Lecture 18: Phylogeny	Prof. Trevor Hodkinson	
Lecture 19: Genetic basis of selection	Prof. Kevin Mitchell	Species Diversity Evolution & Modularity
Lecture 20: Genetic basis of evolution	Prof. Kevin Mitchell	

1: Molecular variation, neutral evolution, molecular clock		
Lecture 21: Genetic basis of evolution 2: Population genetics, Hardy Weinberg Equilibrium, Genetic Drift, Selection	Prof. Dan Bradley	
Lecture 22: Genetic basis of evolution 3: Population genetics	Prof. Dan Bradley	
Lecture 23: Human evolution: humans in the tree of mammals, origins of modern humans.	Prof. Laetitia Chauve	
Lecture 24: Summary of key concepts: Q&A	Prof. Trevor Hodkinson	
Section 3 Ecology and Environment		
Lecture 25: Species - Commonness, rarity and population processes	Prof. James Barnett	
Lecture 26: Species - Conservation	Prof. James Barnett	Biodiversity & Ecosystems Services
Lecture 27: Trophic cascades and rewilding	Prof. James Barnett	
Lecture 28: Constructing ecosystems and conservation	Prof. James Barnett	
Lecture 29: Urban ecology	Prof. James Barnett	
Lecture 30: Ecosystem services and natural capital	Prof. James Barnett	Biological Environmental Systems
Lecture 31: Global ecology and climate change	Prof. Jennifer McElain	
Lecture 32: Impacts of Climate Change Biological Niches	Prof. Jennifer McElain	
Lecture 33: Biomes and Global Productivity	Prof. Jennifer McElain	
Lecture 34: Biogeochemical Cycles	Prof. Jennifer McElain	
Lecture 35: Biodiversity Crisis	Prof. Jennifer McElain	
Lecture 36: Summary of key concepts: Q&A	Profs Jennifer McElain/ James Barnett	

Lecture Content:

- **Introduction to development:** core concepts, model organisms, analysis of development; morphology, genetic, biochemical.
- **Embryogenesis and morphogenesis:** germ layers

- **Intercellular communication:** determination, potency, axis formation – anterior-posterior, dorsal-ventral.
- **Pattern formation**: morphogens, gradients, and thresholds.
- **Differential gene expression**: temporal and spatial, master regulators.
- **Form and Function**: functional characteristics of living things; specialisation of cells/tissues/organs to fulfil specific functions.
- **Homeostasis**: the concept of the internal environment; composition, temperature, pH etc. of body fluids; maintenance of homeostasis by cooperation of different physiological systems; feedback and feed-forward.
- **Physiological Regulation of Function**: fundamentals of nervous and endocrine control of function and comparison of speed and modes of action**:** how an individual organism senses and responds to changes in the external and internal environments.
- **Pre-neuroscience history of mind/brain ideas**: cartesian dualism and materialist and non-materialist explanations of mind; the brain as the substrate of mind; the effects of head trauma on behaviour and memory, anatomy of the human/mammalian brain, functions in behaviour and in homeostasis, overview of human brain regions and attribution of various regions to broad functions (evidence from lesions, imaging).
- **Fundamentals of nervous system structure and function**: reticular vs. neuron theory, nervous system as electrically active, Helmholtz and excitable neurons, action potentials & synaptic transmission.
- **Introduction to the biology of memory storage:** challenges of integrating neurobiology and brain function at multiple levels; reductionism and correlation vs. causation; the biology of memory storage.
- **Short history of life**: timeline, major groups, diversity.
- **Selection/modern synthesis**: adaptation
- **Species**: definitions, taxonomy, diversity, species rich groups.
- **Speciation**: allopatric, sympatric, adaptation, radiations, key innovations.
- **Extinction**: fossils, global change (climate, atmosphere, tectonic).
- **Phylogeny:** homology, convergence, reversals, methods.
- **Genetic basis of selection**
- **Genetic basis of evolution**: molecular variation, neutral theory, drift; molecular evolution of population genetic variation.
- **Human evolution**
- **Global ecology and climate change:** future climate change – global challenges – projections; pest diseases, human physiology, how to predict; need to understand fundamentals of ecology to address these global challenges.

- **Biomes, niches:** introduction to biomes, what shapes biome distribution? climate change, climate niches / fundamental versus realized niche; challenge of predicting future ecological responses to climate change
- **Commonness, rarity, and population processes: e**xtinction or persistence are processes that operate at the population level; introduction to concepts of abundance and rarity, competition, dispersal, demography and its application to conservation (endemism and invasions).
- **Conservation:** applications of population biology at the species level, including prioritizing species for conservation management, assessing threat and red listing.
- **Trophic cascades and rewilding:** what is a community**,** energy flow, applications of community ecology to conservation and rewilding challenges; consumption, facilitation & predation.
- **Constructing ecosystems and conservation**: in the Anthropocene humans have constructed new ecosystems, what are they, where do we find them and what are their values? Contrast with "natural" ecosystems.
- **Urban ecology**: how have organisms adapted to living in urban environments? How can we better design our cities and buildings to gain more value from nature and support biodiversity?
- **Ecosystem services and natural capital**: nature provides many valuable ecosystem services supported by natural capital; introduction to the concepts and controversies surrounding the ecosystem services and natural capital concepts.
- **Food: environmental impacts and ecological process**: food security- ecological concepts- productivity- energy flows through ecological systems/basic concepts of biogeochemical
cycles.
- **Future food and a changing planet**: food security; ecological concepts, human population increase, projections for future productivity.
- **Biosphere feedbacks on climate system**: introduction to biological feedbacks on the climate system; carbon sequestration/ transpiration/ water budget, within biomes; fire feedbacks/rain seeding; nature-based solutions to climate mitigation and adaptation; green and blue solutions – cities etc., 'The Martian' closed system.

Recommended Textbook:

Campbell Biology, 12th Edition by Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece (Published by Pearson, 2021)

Assessment Details: Assessment Details:

(A) **End-of-semester examination: 50% of module mark.** The exam format will be closed book, in-person, fifty multiple-choice questions drawn from across the lecture course, 2 hours allowed, and **NO** negative marking will apply.

(B) **Coursework: 50% of module mark.** Coursework includes compulsory attendance at laboratory sessions, assignments associated with practical's, in-course essay and MCQ tests of lecture material. Marks breakdown across the various components will be published in Blackboard.

Further Information

Plagiarism

Students should note that College penalties for plagiarism apply to both examinations and continuous assessment.

Late work

A penalty of 10% deduction in the final mark for every week or part of a week late.

Missed classes/assessments

The attendance at all scheduled classes for this module is compulsory. A student who is unable to attend a class for any reason must notify the science course office here of the reason for absence without delay, and present certification as appropriate.

Non-satisfactory reports

Students who have not fulfilled the module requirements with regard to attendance and/or coursework may be reported to the Senior Lecturer as non-satisfactory for one or more terms. Students reported as non-satisfactory for the Michaelmas and Hilary terms may be refused permission to take their formal University assessment sessions and may be required by the Senior Lecturer to repeat the year.

Compensation

Students must obtain an overall module mark of 40% to pass the module.

Contact details:

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CHU11101: General and Physical Chemistry

Semester 1, 10 credits

Rationale and Aims:

To provide a general introduction to chemistry and physical chemistry and equips the student with the knowledge to understand the basic concepts in chemistry, understanding of the building principles of matter, chemical bonding and molecular structure, an introduction to thermodynamics, electrochemistry, acid/base reactions and to the chemistry of liquids, solids, and solutions.

Content Layout

Teaching Week	Topic
1-4 (15 L)	**Introduction to General Chemistry** • Motivation for studying chemistry; physical states of chemical matter; classification of matter, physical and chemical properties of pure substances and mixtures; extensive and intensive properties; chemical analysis. • Measurements and units; the international system of units; derived units, the reliability of measurements and calculations; significant figures in simple calculations. • Structure and building principles of atoms; element symbols; masses and the mole; introduction to the periodic table; brief introduction to the structure of the electron shell; ionisation energy and electron affinity. • Law of conservation of mass; law of definite composition; bonding in chemical substances; ionic bonding; covalent bonding; weak bonding; molecules and solid-state structures; electronegativity; the periodic table. • Chemical nomenclature of inorganic compounds; stoichiometry; mole, molarity and concentration; interpreting stoichiometric coefficients; sample calculations. • Chemical reactions; symbolizing reactions; balancing equations; limiting reagents and yields; role of water in chemical reactions; important classes of chemical reactions; precipitation reactions; examples of precipitation reactions in chemistry net ionic equations. • Introduction to acid and base reactions; acid-base titration, • Introduction to oxidation and reduction reactions; oxidation number and electron transfer; oxidizing and reducing agents; half-reactions.

	General Chemistry: Structure, Bonding, and Periodicity • The electronic theory of chemistry: • The spectrum of atomic hydrogen; wave properties of particles; the structures of many-electron atoms. • Orbital energies. • building-up principle. • Lewis structures of polyatomic molecules. • Bond parameters. • Charge distribution in compounds. • Assessing the charge distribution. • Polarization. Ionic and atomic radii. • A survey of periodic properties; Periodicity and trends cross the periodic table; Electronic and physiochemical changes of metals, metalloids and non-metals across the periodic table. • Periodic nature of ionic and atomic radii, Ionization energy and Electron Affinity, Electronegativity. • The electron-pair bond. Lewis acids and bases. • The Shapes of Molecules. • Valence Shell Electron Repulsion theory. • The arrangement of electron pairs. • Polar molecules. • Hybridization. • A perspective on chemical bonding.
5-12 (24 L)	**Introduction to Physical Chemistry** • The ideal gas law • Kinetic molecular theory of ideal gases • Differences between real and ideal gases • The First Law of Thermodynamics • Internal Energy, Enthalpy and Calorimetry • Cp and Cv, expansion/compression of gases. Adiabatics. • The Second Law of Thermodynamics: entropy • The Carnot cycle • Gibbs' Free Energy • Chemical Equilibrium • Boltzmann's Factor • Acids-Bases and Titrations • Electrochemistry: Nernst equation, electrochemical potential, galvanic cells, electrolysis • Phases of state • Intermolecular forces – origin, distance-dependence and effect on properties • Structure and packing of solid structures and their properties.

	• Properties of liquids – viscosity, surface tension, vapour pressure • Water – the universal solvent • Phase transitions and phase diagrams • Thermodynamics and phase transitions • Solutions: liquids in liquids, gases in liquids, solids in liquids • Thermodynamics of solvation • Colligative properties

Reading list/ Indicative Resources

- Chemistry & Chemical Reactivity Hardcover by Paul Treichel, John Kotz, John Townsend, David Treichel; Publisher: Brooks Cole; 9 ed.
- Atkins, P.W. & de Paula, J. (2011) Physical Chemistry for the Life Sciences, 2nd Edition, W H Freeman & Co
- Inorganic Chemistry, by C. E. Housecroft and A. G. Sharpe, Publisher: Pearson, 2018, 5th ed.
- Inorganic Chemistry by Gary *Miessler*, Paul *Fischer*, Donald *Tarr*, Publisher: Pearson, 2021, 5th ed.

Methods of Teaching and Student Learning

A mixture of lectures, tutorials and hands-on laboratory practicals are used in the delivery of this module. The practical sessions are formatted in order to further clarify concepts thus reinforcing learning. A weekly hour of tutorial problem solving activities provides an additional opportunity for the lecturer to assess understanding and gauge the knowledge level of the students.
All lecture notes and problem sheets and a selection of self-assessment quizzes are available for students on Blackboard.

Learning outcomes

On completion of this module the student should be able to:

- Explain, using appropriate terminology and physical units, basic concepts in chemistry, including precipitation and redox reactions.
- Analyse bonding and atomic molecular structure
- Describe the chemical and physical properties of elements as a function of their position in the periodic table.
- Identify, determine, and explain the origin of the trends within groups and across periods of the properties of elements in the periodic table.
- Describe the typical structures of some common compounds of the main group elements.
- Classify elements as metallic/metalloid/non-metallic and contrast their characteristic properties.
- Apply the ideal gas law to calculations of gas properties.
- Describe the principles underpinning the kinetic theory of gases.
- Analyse and identify the main types of intermolecular forces.

- Identify and explain the principal features of the phase diagrams of pure compounds, including pressure dependence of melting and boiling points, triple point and critical point, and variation of vapour pressure with temperature.
- Calculate chemical equilibria and illustrate the key concepts, including variation of components with concentration, temperature, and pressure.
- Discuss simple acid/base chemistry and apply to solution equilibria.
- Illustrate the basic concepts of an electrochemical cell, including half-cell reactions, cell potential and reaction free energy and be able to determine these properties as well as concentration dependence.
- Describe the main classes of the solid-state structure; cubic- and hexagonal close packing; body-centred and face-centred cubic structures. Octahedral and tetrahedral holes, coordination numbers, the Born-Haber cycle, lattice energy.
- Identify, describe, and analyse the factors affecting solubility.
- Define and explain colligative properties, including Raoult's Law and the calculation of molecular weights.
- Understand and apply the concepts underlying the First and Second Laws of Thermodynamics to numerical problems.

Assessment details:

This module will be examined via a combination of in-course assessments (30% of the final mark) and a 3 h examination (70% of the final mark).

Important Note on Examinations, Assessments and Reassessments in the School of Chemistry:

- There is a minimum mark requirement of **35%** in the **Examination** component and the **40% Laboratory** component, in order for a Pass or Qualified Pass mark in this module to be granted. Other components making up fewer marks are not included in this requirement. A mark of less than 35% in the Examination or 40% Laboratory components leads to a Qualified Fail and requires reassessment examination or a repeat of the year.
- There is a maximum mark or cap of 40% on any reassessed component in this module if reassessment is required. The final module mark is calculated based on the reassessed component mark and any already achieved marks for components that did not need to be reassessed, according to the published weightings of these components.
- Re-assessment capping does not apply to deferred 1st attempts at assessment.
- These requirements apply to all students in this module.
- For more details see the section on 'Progression Regulations applying to Chemistry modules' under the 'Progression and Awards' within this booklet.

Contact Details:

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CHU11102: Introduction to Inorganic and Organic Chemistry

Semester 2, 10 credits

Content Layout

Teaching Week	Topic
1-8 (28 L)	**Introduction to Organic Chemistry** • Alkanes, isomers, homologous series, IUPAC nomenclature, physical properties and molecular size, the tetrahedral carbon atom, shapes of organic molecules, alicyclic rings, concept of bond strain, conformations of ethane and of the cyclohexane ring, chair and boat forms and their relative stabilities, axial and equatorial bonds. • Alkenes, nomenclature, the double bond as an electron rich centre mechanism of electrophilic addition of hydrogen halides, water, and halogens to the double bond, Markownikoff rule, shape of the double bond, geometric isomerism, cis-trans isomers and *E-Z* nomenclature, catalytic hydrogenation, oxidative cleavage of double bonds including ozonolysis. • Alkyne reactions treated briefly as a simple extension of alkene reactions, acidity of alkynes and nucleophilic character of the alkyne anion. • Introduction to aromaticity: benzene structure. Resonance forms and Kekulé structures. Nomenclature. Orbital picture - Consequences of structure. Stability. Quantification of resonance stabilisation energy. Electrophilic addition reactivity. Electrophilic aromatic substitution. Mechanism. Reaction types. Bromination. Nitration. Sulfonation. The Friedel-Crafts reaction. Friedel-Crafts. • Alkyl halides, idea of leaving group, introduction to the use of curly arrows in representing mechanism, idea of nucleophiles and electrophiles, nucleophilic substitutions, SN1 and SN2 mechanisms, carbocations, dehydrohalogenation, elimination mechanisms E1 and E2 emphasising common intermediate for SN1 and E1, direction of elimination, Saytzeff rule, organo lithium and Grignard reagents as carbon nucleophiles. • Alcohols, hydrogen bonds, differences between primary secondary and tertiary, amphoteric nature of the OH group, alkoxides, mechanism of dehydration, oxidation. • Amines as bases and as nucleophiles. • Aldehydes and ketones, nucleophilic attack on the carbonyl carbon, cyanohydrins, oximes, hydrazones, Grignard products, acetals and the mechanism of their formation, oxidation and

	reduction of the carbonyl group, keto-enol tautomerism, the enolate anion, resonance, haloform reaction, aldol condensation. • Carboxylic acids, acid strength, carboxylate anions, esters, acid halides, acid anhydrides, amides, emphasis on electrophilic nature of the carbonyl group, mechanism of esterification and hydrolysis.
9-12 (14 L)	• Introduction to Inorganic Chemistry 1 • This section of the module covers an introduction to inorganic chemistry, with emphasis on bonding, molecular orbital treatment of bonding, and an introduction to coordination chemistry. • Introduction to Molecular Orbital Theory (7 L) • Atomic orbitals (s,p,d) as wave functions; their representation as enclosed boundary surfaces and as radial distribution functions. The relationship of these ideas to the Bohr model for atomic hydrogen. Relative energies of these orbitals; orbital angular momentum in non-hydrogen-like atoms; penetration and shielding. • Hybridisation of atomic orbitals and the hybrids associated with various geometries; VSEPR treatment of molecular structures. • Bonding as the linear combination of atomic orbitals, including non-bonding and anti-bonding interactions. Labelling of molecular orbitals as sigma, pi (g or u), molecular orbital diagrams of homonuclear diatomic molecules of the first and second row of the Periodic Table. Mixing of molecular orbitals and its effect on the relative energies of the resulting molecular orbital diagram. Molecular orbital approach for simple molecules including H2O, BeH2 and BCl3. Reactivity of CO in terms of the molecular orbital energy diagram for this molecule. Appreciation of the Molecular Orbital basis of the spectrochemical series. • Introduction to Coordination Chemistry • Brief introduction - why study metal complexes? • What is a metal complex? Overview of concepts and definitions: Lewis Acid-base concept. • Formation and stability of metal complexes: Complex formation and dissociation; cumulative stability constants and trends; the 'chelate effect'; factors affecting stability. • Classification of common ligands: Donor atoms and functional groups. Multidentate and chelating ligands; stereochemistry and formation of chelate rings. • Stereochemistry of metal complexes. Coordination numbers 2-6 and geometry of metal complex; square planar, tetrahedral;

	trigonal bi-pyramid; square based pyramid; octahedral; distortion of geometries. • Electronic structure and properties of transition metal complexes: Ionic vs. covalent bonding models; crystal field theory; energy level diagrams in tetrahedral - octahedral fields. • 18-electron rule , Molecular Orbital Diagrams for Octahedral Complexes, M-L σ and π bonding • Consequences and applications of orbital splitting: Electronic configurations of metal complexes; crystal filed stabilization energies (CFSE); Factors effecting Delta; spectrochemical series; HS and LS configurations; magnetic properties and the spin-only formula. • Electronic spectra of metal complexes: UV-vis. Spectra; interpretation of data; Laporte and spin selection rules; extinction coefficients and wavelength; Jahn-Teller effect.

Reading list/ Indicative Resources

- Fundamentals of Organic Chemistry, by John E. McMurry and Eric E. Simanek
- Chemistry & Chemical Reactivity Hardcover by Paul Treichel, John Kotz, John Townsend, David Treichel; Publisher: Brooks Cole; 9 ed.
- Organic Chemistry, by Jonathan Clayden and Nick Greeves; Publisher: OUP Oxford; 2 ed.
- Inorganic Chemistry, by C. E. Housecroft and A. G. Sharpe, Publisher: Pearson, 2018, 5th ed.
- Inorganic Chemistry by Gary *Miessler*, Paul *Fischer*, Donald *Tarr*, Publisher: Pearson, 2021, 5th ed.

Methods of Teaching and Student Learning

A mixture of lectures, tutorials and hands-on laboratory practicals are used in the delivery of this module. The practical sessions are formatted in order to further clarify concepts thus reinforcing learning. A weekly hour of tutorial problem solving activities provides an additional opportunity for the lecturer to assess understanding and gauge the knowledge level of the students.

Learning outcomes

On completion of this module the student should be able to:

- Identify and explain bonding, hybridisation, and mechanisms.
- Describe and explain the chemistry of functional groups (alkanes, alkenes and alkynes, aromatics, alkylhalides, alcohol, aldehydes, ketones, and amines) and their applications.
- Analyse and discriminate between mechanisms in terms of the inherent reactivity/polarisation etc. of the two reaction components.
- Identify and classify chiral centres in organic molecules.

- Describe the chemical and physical properties of elements as a function of their position in the periodic table.
- Determine and explain the origin of the trends within groups and across periods of the properties of elements in the periodic table.
- Describe the typical structures of some common compounds of the main group elements.
- Classify elements as metallic/metalloid/non-metallic and contrast their characteristic properties.
- Explain the practical and industrial uses of key elements and compounds and relate these to their properties.

Module Prerequisite:
CHU11101 General and Physical Chemistry (First Semester)

Assessment details:
This module will be examined via a combination of in-course assessments (30% of the final mark) and a 3 h examination (70% of the final mark).

Important Note on Examinations, Assessments and Reassessments in the School of Chemistry:

- There is a minimum mark requirement of **35%** in the **Examination** component and the **40% Laboratory** component, in order for a Pass or Qualified Pass mark in this module to be granted. Other components making up fewer marks are not included in this requirement. A mark of less than 35% in the Examination or 40% Laboratory components leads to a Qualified Fail and requires reassessment examination or a repeat of the year.
- There is a maximum mark or cap of 40% on any reassessed component in this module if reassessment is required. The final module mark is calculated based on the reassessed component mark and any already achieved marks for components that did not need to be reassessed, according to the published weightings of these components.
- Re-assessment capping does not apply to deferred 1st attempts at assessment.
- These requirements apply to all students in this module.
- For more details, see the section on ‘Progression Regulations applying to Chemistry modules’ under the ‘Progression and Awards’ within this booklet.

Contact Details:

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Administrative Officer: Ms Anne Marie Farrell	E-mail: farrea25@tcd.ie Phone: 01 896 1726

GSU11001: Spaceship Earth: An Introduction to Earth System Science

Semester 1, 10 credits

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 challenges 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.

Module learning aims.

To provide foundation-level knowledge of:

- Fundamental concepts of Earth systems science and the theoretical basis of the 'systems approach' in Geography and Geoscience
- Character and scope of Earth's principal sub-systems: Geosphere, Hydrosphere, Atmosphere, Biosphere and Anthroposphere
- Composition / structure of the solid Earth (Geosphere) and the principal processes / drivers responsible for its formation and evolution
- Composition / structure of atmosphere and ocean, the physical processes / drivers of their circulation, and the nature of coupling between them
- Weather and climate at a global scale including climate change past, present and future.
- Biogeochemical cycling and the role of interconnected biotic and abiotic systems in the maintenance of life on Earth
- Ecological and historical biogeography including fundamentals of ecology, evolution, and extinction.
- Nature and scope of human impacts on the Earth system including the 'Anthropocene' concept.

To develop the following skills & graduate attributes

- Digital skills to manipulate and analyse geographical data, including use of Google Earth and Excel
- Self-motivated and reflective approach to independent learning, including completion of assigned reading, activities, and formative assessment.
- Make connections between a student's core subject areas and the field of geography & geoscience.

Recommended Reading List:

Holden, J. (2019) An Introduction to Physical Geography and the Environment. 4th Edition. Pearson: Harlow, UK. 876 pages. Skinner, B.J., Murck, B. (2011) The Blue Planet: An Introduction to Earth System Science. 3rd Edition. J. Wiley & Sons: Hoboken, USA. 656 pages.

Assessment Details:

Assessment Details:
(A) End-of-semester examination: 50% of module mark. The exam format will be closed-book, in-person, with fifty multiple-choice questions drawn from across the lecture course.

(B) Coursework: 50% of module mark. In-course activities and associated MCQ quizzes. Details and mark breakdowns will be published in Blackboard.

Module Website: Blackboard

Contact Details:

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Geology Department: Executive Officers: Ms Debora Dias	E-mail: TR062Admin@tcd.ie Ph: 01 896 1074

GSU11005: Introduction to Geology: A Beginner's Guide to Planet Earth

Semester 2, 10 credits

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.

Module learning aims

To provide foundation-level knowledge of:

- Fundamental concepts and principal methods employed in the science of geology.
- Planetary origins and evolution of planet Earth
- Rock types, composition, classification, and transformation
- Structure of planet Earth and plate tectonic theory
- The distribution and causes of geohazards (volcanoes, earthquakes, tsunamis)
- Fossil evidence of the origins and evolution of life on Earth
- Geological evidence of past environments and climatic conditions
- Economic geology and the nature of geological resources

To develop the following skills & graduate attributes

- Written and digital / analytical skills
- Critical thinking
- Make connections between a student's core subject areas and the science of Geology.

Module learning outcomes.

On successful completion of this module students will be able to:

- Outline the origin and evolution of planet Earth.

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

Recommended Reading List:

Nicholas, C. J., 2019. A Beginner's Guide to Planet Earth: Introductory Lectures in Geology. C.J. Nicholas (ISBN 978-1-911180-33-3)

Assessment Details: 60% examination; 40% continuous assessment via in-course tests and assignments.

Module Website: https://www.tcd.ie/Geology/undergraduate/modules/year1/

Contact Details:

Course Director TR062	
Geography and Geosciences:	mcclens@tcd.ie
Dr. Sean McClenaghan	
	Phone: 01 896 1074
Geography Department Executive Officer:	geog@tcd.ie
Ms. Helen O'Halloran	Ph: 01 0896 1576
Geology Department Executive Officer:	TR062Admin@tcd.ie
Ms Debora Dias	Ph: 01 896 1074

Important Information

College Registration

You will complete College registration online via the website my.tcd.ie. Registration will open on a course-by-course basis. A communication will be sent to the e-mail address you supplied during the application process inviting you to log in to the Academic Registry website to register. When you receive your TCD email address, check it regularly Please check your TCD email address regularly as that will then be the address to which all Trinity communications will be sent.

All information regarding College registration is available at the following link: http://www.tcd.ie/academicregistry/registration/

Please Note: Students who have already accessed the my.tcd.ie website should continue to access it using your current username and password as this will not change. For those who have not previously logged on, a username and password has been created to give you immediate access.

Closing Dates for Course Transfer

If you decide to transfer out of your course altogether, you must submit an application for **transfer of course** to the Academic Registry, following discussion with your tutor. Decisions are based on **a)** the availability of places, and **b)** the entry qualifications of the transfer applicant. It may not be possible to permit transfers to subjects which already have a full complement of students. Further details are available on the following link: http://www.tcd.ie/study/apply/making-an-application/undergraduate/index.php

Students may not register or attend a course until their application to transfer has been formally approved by the Senior Lecturer

Progression and Awards

Information on progression and awards can be found via the following webpage: https://www.tcd.ie/teaching-learning/academic-affairs/ug-prog-award-regs/index.php

Information in relation to all undergraduate Regulations can be found via the following: https://www.tcd.ie/teaching-learning/academic-affairs/ug-regulations/

Attendance/ Non-Attendance Regulations for Junior and Senior Fresh Students

The following regulations will apply to Junior and Senior Fresh student in the following Science Courses:
TR060: Biological and Biomedical Science
TR061: Chemical Sciences
TR062: Geography and Geoscience
TR063: Physical Sciences

All students must begin attendance for their course no later than the first day of teaching term and must fully take part in the academic work of their course. Attendance at Lectures, Labs, Field trips and tutorials is **compulsory** in both core and open modules. Timetables are published through the my.tcd.ie portal and the onus lies with the student to inform themselves of dates, times and venues by consulting the timetable regularly.

Attendance at chemistry practical classes is compulsory for all students in all years of Chemical Sciences TR061, and for students in other science streams (Physical Sciences TR063 and Geosciences TR062) that may take chemistry modules as open modules in JF and SF years.

It is extremely important that students meet all the requirements of their course and that they submit all continuous assessments, Laboratory practical/Field course reports and assignments by the required deadlines. Students should ensure that they make themselves aware of the module weightings which are outlined in the relevant booklets available from the Science Course Office website: https://www.tcd.ie/science/undergraduate/

Non-Satisfactory Attendance in Science

All Junior and Senior Fresh students must fulfil the course and module requirements as set out above with regard to attendance. At the end of teaching term students who have not satisfied these regulations may be reported as non-satisfactory for that term. Students whose attendance is reported as non-satisfactory may be refused permission to take their semester one or semester two examinations and may be required to repeat the year.

Science students will be considered non-satisfactory in a module if:

They fail to attend at least 2/3 of the laboratory practicals/field trips in a module.
OR
They fail to submit at least 2/3 of the required coursework/assignments in a module.

Email Protocols for Students

Every student has a TCD email address. You are expected to check this regularly and to read and act promptly upon all messages sent to you.

You should check your College email daily during teaching term as it will be used to communicate important information. If away from Trinity on Erasmus or on an exchange you should still check your TCD mail periodically.

Sending emails. Email is a useful way of contacting lecturers and administrators with queries about course work, to arrange an appointment, or to request a letter of recommendation. Email within College is essentially work-related, so it is appropriate to be relatively formal.

Subject Lines. When sending email, please fill in the subject line so as to indicate the purpose of the email. This will help the recipient to answer your query and to recover the email subsequently if necessary.

Forms of address. As a courtesy, emails should address recipients by name. If you are using titles (Ms.; Mrs.; Mr.; Dr; Professor) these should be accurate. If you are unsure as to a name or title this can be checked in this handbook.

Introducing yourself. If you are writing to a member of staff, make sure your complete name and student number appears somewhere in the email. If your email relates to a particular module, include the module code and title.

Expectations re response. Responses to email should only be expected during normal working hours, i.e. from 9.00am to 5.00pm, Monday to Friday. You should not expect academic or administrative staff to respond to your emails at weekends or when College is closed during holiday periods.

Civility. Always be civil. Abusive and/or abrasive correspondence will not be tolerated.

Be secure. Beware of phishing, never divulge your account details to non-TCD addresses and do not click on links from unknown sources.

Academic Integrity

Plagiarism is using someone else's ideas, charts, concepts, or words in your assignments and using them as if they were your own, and without giving credit to the actual author. Plagiarism is considered a serious offence in Trinity and carries penalties depending on the severity of the 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

- Academic Integrity homepage (formerly Avoiding Plagiarism): https://libguides.tcd.ie/academic-integrity
- Ready Steady Write tutorial: https://libguides.tcd.ie/academic-integrity/ready-steady-write
- Coversheet declaration: https://libguides.tcd.ie/academic-integrity/declaration
- Levels and consequences: https://libguides.tcd.ie/academic-integrity/levels-and-consequences

Correct referencing is essential when crediting your sources and avoiding plagiarism. Your course handbook will tell you what style of referencing you should use in your assignments so be sure to check that out before you start any assignments. You will waste a lot of time if you have to redo your references.

Resources

Referencite, University of Auckland, New Zealand has some good interactive resources to help you understand plagiarism and how to avoid it: https://www.auckland.ac.nz/en/law/current-students/llb-information/academic-information/cheating-plagiarism-turnitin.html

Guidance on the Use of AI and Generative AI in College

The advent of commonly available artificial intelligence tools is disruptive in both positive and negative ways. Before using them in your studies, you must familiarise yourself with the College policies on their use. Unless otherwise instructed for particular modules or assessments, **the default expectation would be that you do not submit AI generated content as an attempt at an assessment.**

Below is some basic overview of the College policy on AI and GenAI. This has been taken from the more detailed policy, which is informative and wide ranging. You are expected to have read and familiarised yourself with this policy.
https://www.tcd.ie/academicpractice/resources/generative_ai/

Artificial Intelligence (AI)

Artificial intelligence is generally understood to be a set of technologies that enable computers to perform a variety of functions usually perceived as requiring human intelligence – for example, understanding speech, recognising objects in images, composing written answers and problem reasoning. A more formal definition of an AI system from the European Union AI Act (2024) is:

...a machine-based system designed to operate with varying levels of autonomy and that may exhibit adaptiveness after deployment and that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments[.] (EU AI Act 2024)

Generative Artificial Intelligence (GenAI)

Generative AI is the sub-area of AI, involving AI systems which generate content — for example, human dialogue, speech, images and video. GenAI systems are capable of generating such content based on a user's request or instruction. More formally, GenAI is defined by UNESCO **as "an artificial intelligence (AI) technology that automatically generates content in response to prompts written in natural-language conversational interfaces" (UNESCO 2023).**

AI and GenAI in Trinity

As Ireland's leading university and as a world leader in AI research, Trinity recognises that AI and GenAI offer new opportunities for teaching, learning, assessment and research. We also recognise that these technologies present challenges and risks, including to academic integrity, ethics, privacy, impartiality, intellectual property and sustainability.

Acknowledging these opportunities and challenges, Trinity commits to supporting the opportunity for students and staff to become AI literate and fluent, thereby helping them to navigate and respond to the challenges and risks of AI and GenAI in order to harness the potential of (Gen)AI to enhance teaching, learning, assessment and research – and to be prepared for future challenges as these technologies evolve. We also commit to providing ongoing resources and guidance to support students and staff to use AI and GenAI in ways that are appropriate, responsible and ethical – and to ensure that academic integrity is maintained in its usage.

College aspires to develop best practice guidelines in this area. In addition to the resources and supports that College provides and recognising that appropriate uses of AI and GenAI tools vary across academic disciplines, Schools will have some flexibility to customise their own discipline-specific practices in line with this institutional statement, other institutional policies as they develop, and national and international regulation. The College goal is to enable overall consistency in the regulation of GenAI usage, while also respecting where disciplines or degree programmes require specific restrictions in GenAI usage in assessment preparation and execution. Thus, where disciplines or degree programmes wish to refine specific regulations on student use of GenAI for learning, general as well as programme-specific regulations should be communicated in the relevant discipline/degree programme handbook.

Such regulation could range from how student GenAI usage is acknowledged or cited within student assessment submissions, to prohibition of GenAI usage in the production of student assessment submissions.

Trinity Tutorial Service

The Tutorial Service is unique, confidential and available to all undergraduate students offering student support in all aspects of College life. The Tutorial Service is supported and co-ordinated by the Senior Tutor's Office which is located on the ground floor in House 27.

Opening Hours

The Senior Tutors Office is open Monday – Friday from 9am – 5.30pm. Closed for lunch from 1-2pm.

Appointments

If you require specific advice or would like a confidential meeting with the Senior Tutor, you can make an appointment by telephoning +353 1 896 2551 or by emailing stosec@tcd.ie

What is a Tutor?

A Tutor is a member of the academic staff who is appointed to look after the general welfare and development of the students in his/her care. Whilst the Tutor may be one of your lecturers, this is not always the case as the role of the College Tutor is quite separate from the teaching role.

When should I go to see my Tutor?

Whenever you 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 him/her permission to do so, s/he will not give any information to anybody else, whether inside College or outside (to your parents/family for example). Your Tutor can only help you if s/he knows you are facing difficulties, so if you are worried about anything go and see your Tutor before things get out of hand.

Further information on the Senior Tutors Office and College Tutors may be found via the following webpage: **Senior Tutor's Office –**
https://www.tcd.ie/seniortutor/students/undergraduate/

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 Service – contact details are available via their webpage: https://www.tcd.ie/disability/contact/

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) 8961407
Email: student-counselling@tcd.ie

For further information visit the following webpage:
https://www.tcd.ie/Student_Counselling/

Helpful College Websites

In the first few weeks at College, you will hear an array of abbreviations, titles, and place names. So, visit the jargon buster page: https://www.tcd.ie/students/jargon-buster/

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

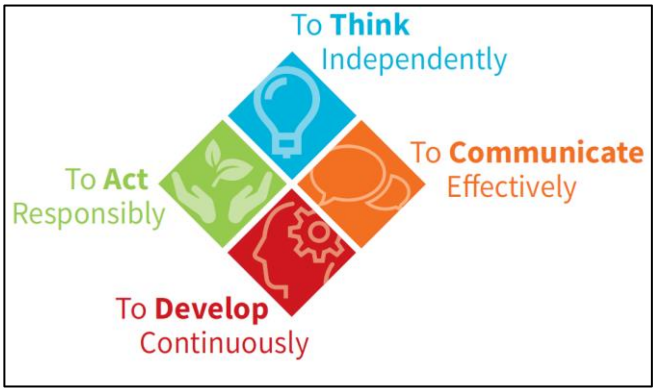
For information on Registration, Fees, Grants, ID Cards, etc. visit the Academic Registry (AR) in the Watts Building or visit the AR website: https://www.tcd.ie/academicregistry/

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 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.

Dates to Note:

Fresh Orientation:	15th September to 19th September 2025
Semester one term dates:	15th September to 05th December 2025
Study Week Semester 1:	27th October to 31st of October 2025
Semester one examinations:	11th December to 22nd of December 2025
Semester two term dates:	19th January to 10th of April 2026
Study week semester 2:	02nd March to 06th of March 2026
Semester two examinations:	21st April to 1st of May 2026

TEACHING TERM DATES 2025-2026					
Michaelmas Term Monday 15 September - Friday 05 Dec 2025			**Hilary Term Monday 19 January 2026 - Friday 10 April 2026**		
Teaching wk. 1	Week 03	*15 Sept 19 Sept	Teaching wk. 1	Week 22	19 Jan - 23 Jan
Teaching wk. 2	Week 04	**22 Sept - 26 Sept	Teaching wk. 2	Week 23	26 Jan – 30 Jan
Teaching wk. 3	Week 05	29 Sept - 03 Oct	Teaching wk. 3	Week 24	*02 Feb - 07 Feb
Teaching wk. 4	Week 06	06 Oct – 10 Oct	Teaching wk. 4	Week 25	09 Feb - 13 Feb
Teaching wk. 5	Week 07	13 Oct - 17 Oct	Teaching wk. 5	Week 26	16 Feb - 20 Feb
Teaching wk. 6	Week 08	20 Oct – 24 Oct	Teaching wk. 6	Week 27	23 Feb – 27 Feb
Study week	**Week 09**	**27 Oct - 31 Oct**	**Study week**	**Week 28**	**02 Mar - 06 Mar**
Teaching wk. 8	Week 10	*03 Nov - 07 Nov	Teaching wk. 8	Week 29	09 Mar - 13 Mar
Teaching wk. 9	Week 11	10 Nov - 14 Nov	Teaching wk. 9	Week 30	*16 Mar - 20 Mar
Teaching wk. 10	Week 12	17 Nov - 21 Nov	Teaching wk. 10	Week 31	23 Mar - 27 Mar
Teaching wk. 11	Week 13	24 Nov - 28 Nov	Teaching wk. 11	Week 32	*30 Mar - 03 Apr
Teaching wk. 12	Week 14	01 Dec – 05 Dec	Teaching wk. 12	Week 33	06 Apr - 10 Apr

*** Orientation week for new entrants**

**** Teaching begins for all Junior Fresh Students**

October bank holiday – Monday 27th October 2025
College will be closed from the 24th of December to the 1st of January 2025
February bank holiday – Monday 2nd February 2026

St Patrick's Day - Tuesday 17th March 2026

Contacts Details

Physical Sciences Course Director

Professor Plamen Stamenov	Ph: 01 896 4350 E-mail: Stamenov.Plamen@tcd.ie

Junior Fresh Physics Coordinator

Professor Evan Keane	E-mail: Evan.Keane@tcd.ie

School of Physics Executive Officer

Ms. Una Dowling	E-mail: dowlingu@tcd.ie Ph: 01 896 1675

Science Course Office
Associate Dean of Undergraduate Science Education

Professor Andrew Jackson	E-mail: jacksoan@tcd.ie

Science Course Office Manager	E-mail: science@tcd.ie
Ms. Ann Marie Brady	Ph: 01 896 2829
Administrative Officer/ Senior Fresh Coordinator	E-mail: sherwinh@tcd.ie
Ms. Helen Sherwin Murray	Ph: 01 896 2799
Executive Officer/ Front Desk	E-mail: dossanta@tcd.ie
Ms. Andressa dos Santos Melo	Ph: 01 896 1970
Administrative Officer/ Junior Fresh Coordinator	E-Mail: segurar@tcd.ie
Ms. Romarey Segura	Ph: 01 896 2022

Appendix 1

Item	Reference/Source
General College Regulations	Calendar, Part II, General Regulations and Information,Section II, Item 12
Emergency Procedures	In the event of an emergency, **dial Security Services on 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 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 studentssave at least one emergency contact in their phone under ICE (In Case of Emergency).
Health and Safety	Faculty of Science, Technology, Engineering and Mathematics website - https://www.tcd.ie/stem/undergraduate/health-safety.php School Handbooks will have School/Discipline information on Health and Safety.
Data Protection	https://www.tcd.ie/dataprotection/ https://www.tcd.ie/dataprotection/assets/docs/dataprotectionhandbook/DP_Handbook_15042021.pdf
Academic Integrity	https://www.tcd.ie/teaching-learning/academic-integrity/
Research Ethics	https://www.tcd.ie/research/support/ethics-integrity.php
Blackboard	Blackboard
Explanation of Weightings	https://www.tcd.ie/teaching-learning/ug-egulations/Academic_credit_system.php
Assessment and Progression Regulations	https://www.tcd.ie/media/tcd/about/policies/pdfs/academic/assess-acad-prog-nov2021.pdf https://www.tcd.ie/teaching-learning/academic-affairs/ug-prog-award-regs/ Calendar, Part II, General Regulations and Information,Section

	II, Item 35 Academic Policies
Academic Awards	https://www.tcd.ie/teaching-learning/academic-policies/assets/academic-awards-jan2021.pdf
Item	**Reference/Source**
Equality, Diversity and Inclusion	https://www.tcd.ie/equality/
Prizes, medals, and other scholarships	https://www.tcd.ie/media/tcd/calendar/undergraduate-studies/prizes-and-other-awards.pdf
Teaching and Learning Study Abroad	https://www.tcd.ie/global/mobility/outbound/
Marking Scales	Calendar, Part II, General Regulations & Information, Section II, Item 30 Please consult Schools or Disciplines directly or programme handbooks for further information.
Framework of qualifications Trinity Pathways	https://www.qqi.ie/national-framework-of-qualifications Trinity PathwaysTrinity Courses
Capstone (UG Programmes)	https://www.tcd.ie/teaching-learning/ug-regulations/Capstone.php
Careers Information	https://www.tcd.ie/Science/careers/ For further information refer to School/Discipline Handbooks.
Careers Advisory Service	https://www.tcd.ie/Careers/
Attendance Requirements	https://www.tcd.ie/media/tcd/science/pdfs/Science-ABSENCE-NON-SATISFACTORY-regulations---TSPMC-August-2024.pdf https://www.tcd.ie/media/tcd/calendar/undergraduate-studies/general-regulations-and-information.pdf#page=6
Student Cases	https://www.tcd.ie/academicregistry/student-cases/
Student complaints procedures	https://www.tcd.ie/media/tcd/about/policies/pdfs/Student-Complaints-Procedure-21.07.22.pdf
General Examination Guidelines	Exam Guidelines - Academic Registry - Trinity College Dublin
Feedback and Evaluation	Student Evaluation andFeedback Procedure for the conduct ofFocus Groups
Academic Policies and Procedures	https://www.tcd.ie/teaching-learning/academic-policies/
Registration	https://www.tcd.ie/academicregistry/student-registration/
Student supports	https://www.tcd.ie/students/

STEM Schools and Disciplines	https://www.tcd.ie/structure/faculties-and-schools/#d.en.2024679

NOTE: All of the information contained in this booklet is accurate at the time of publication. However, the Science Course Office reserves the right to modify information, dates and times as necessary. Students will be notified of any changes via e-mail and the Science webpage.