



Trinity College Dublin

Coláiste na Tríonóide, Baile Átha Cliath

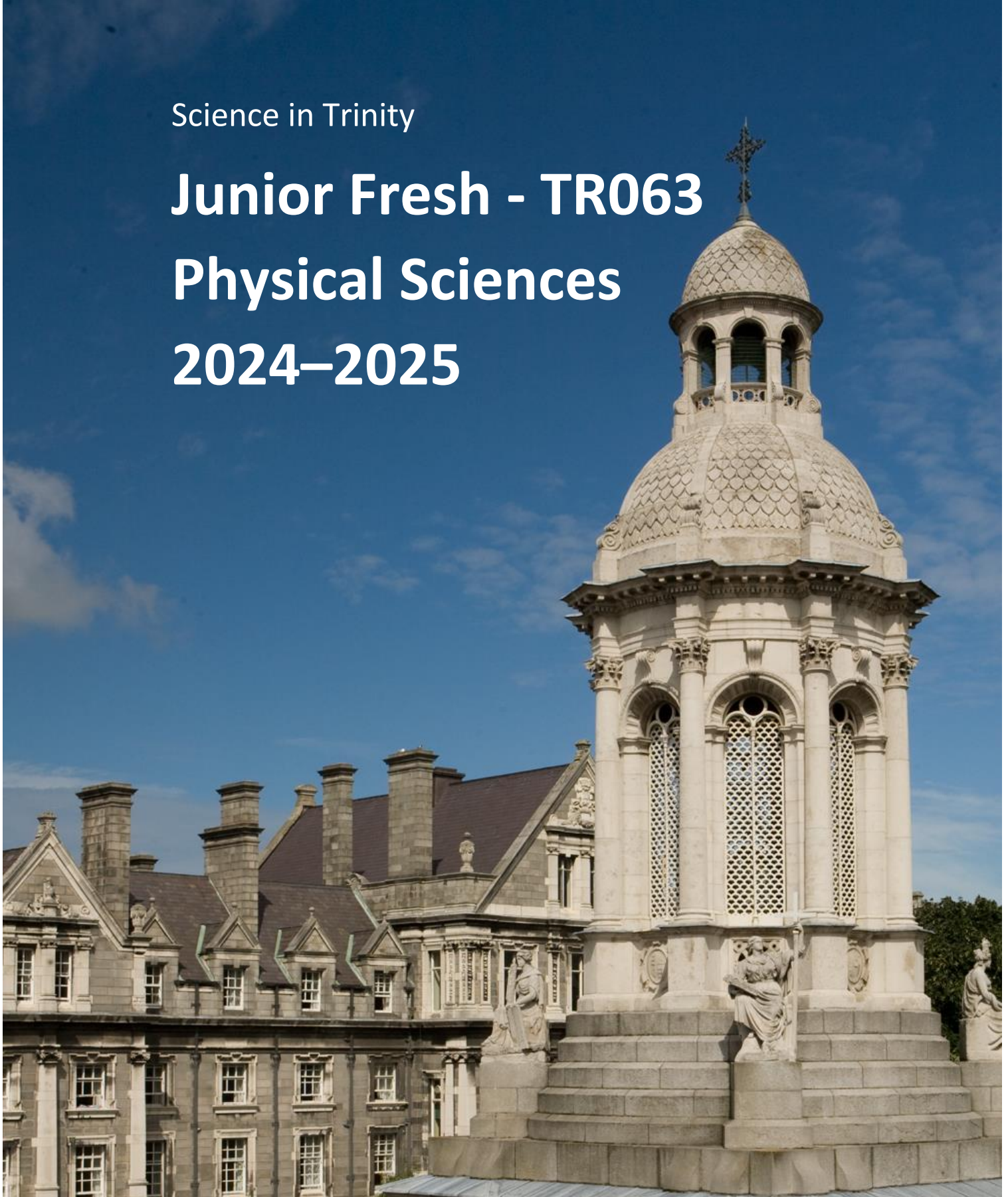
The University of Dublin

Science in Trinity

Junior Fresh - TR063

Physical Sciences

2024–2025



Contents

WELCOME TO PHYSICAL SCIENCES	1
TR063 PHYSICAL SCIENCES OVERVIEW AND MODULE SELECTION.	4
PHYSICAL SCIENCES MODERATORSHIPS	5
MODERATORSHIP IN PHYSICS	5
MODERATORSHIP IN PHYSICS AND ASTROPHYSICS.....	5
MODERATORSHIP IN NANOSCIENCE.....	5
OPEN MODULE CHOICES IN JUNIOR AND SENIOR FRESH YEARS	6
MODERATORSHIPS AND OPEN MODULE CHOICE DIAGRAM	7
SEMESTER STRUCTURE.....	8
TR063 PHYSICAL SCIENCES CORE MODULES	9
PYU11P10: PHYSICS 1	9
PYU11P20: PHYSICS 2	15
MAU11S01: MATHEMATICS FOR SCIENTISTS 1.....	21
MAU11S02: MATHEMATICS FOR SCIENTISTS 2	22
TR063: PHYSICAL SCIENCES – OPEN MODULES	24
BYU11101: FROM MOLECULES TO CELLS I.....	24
BYU11102: ORGANISMS TO ECOSYSTEMS I.....	29
CHU11101: GENERAL AND PHYSICAL CHEMISTRY.....	32
CHU11102: INTRODUCTION TO INORGANIC AND ORGANIC CHEMISTRY	37
GSU11004: SPACESHIP EARTH: AN INTRODUCTION TO EARTH SYSTEM SCIENCE.....	40
GSU11005: INTRODUCTION TO GEOLOGY: A BEGINNER’S GUIDE TO PLANET EARTH.....	42
IMPORTANT INFORMATION	44
COLLEGE REGISTRATION.....	44
CLOSING DATES FOR COURSE TRANSFER.....	44
PROGRESSION AND AWARDS	44
ATTENDANCE/NON-ATTENDANCE REGULATIONS FOR JUNIOR AND SENIOR FRESH STUDENTS.....	44
NON-SATISFACTORY ATTENDANCE IN SCIENCE	46
ACADEMIC INTEGRITY.....	46
TRINITY TUTORIAL SERVICE	48
DISABILITY SERVICES	49
STUDENT COUNSELLING.....	49
HELPFUL COLLEGE WEBSITES:.....	49
GRADUATE ATTRIBUTES	50
DATES TO NOTE:	50
CONTACTS: TR063: PHYSICAL SCIENCES	51
APPENDIX 1: GENERAL INFORMATION	52

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 give you the opportunity 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/e/q7mhE4BtJQ> to select your modules. The forms will not open until the information session is finished, **16th September 16.00 hrs** and it will **close on the 17th September 16.00 hrs**. If you feel that you need assistance with your choices, please contact us at jfsc@tcd.ie and we will be happy to help.

Please note that 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
GSU11004	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
GSU11004 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.

Moderatorships 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		Moderatorship	
		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	Nanoscience	
		CHU11101 General and Physical Chemistry	GSU11005 Geology: A Beginner's Guide to Planet Earth...	GSU22201 From Atoms to Rocks: An introduction to Geochemistry.	GSU22006 Physical Geography: Dynamic Earth		Physics
B		GSU11004 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.	GSU22006 Physical Geography: Dynamic Earth	Physics & AstroPhysics	
		BYU11101 From Molecules to Cells	BYU11102 Organisms to Ecosystems	BYU22201 From Molecules to Cells 2	BYU22202 From Cells to Organisms		
C		BYU11101 From Molecules to Cells	GSU11005 Geology: A Beginner's Guide to Planet Earth	GSU22201 From Atoms to Rocks: An introduction to Geochemistry.	GSU22006 Physical Geography: Dynamic Earth		
		BYU11101 From Molecules to Cells	GSU11005 Geology: A Beginner's Guide to Planet Earth	GSU22201 From Atoms to Rocks: An introduction to Geochemistry.	GSU22006 Physical Geography: Dynamic Earth		
D		BYU11101 From Molecules to Cells	GSU11005 Geology: A Beginner's Guide to Planet Earth	GSU22201 From Atoms to Rocks: An introduction to Geochemistry.	GSU22006 Physical Geography: Dynamic Earth		
		BYU11101 From Molecules to Cells	GSU11005 Geology: A Beginner's Guide to Planet Earth	GSU22201 From Atoms to Rocks: An introduction to Geochemistry.	GSU22006 Physical Geography: Dynamic Earth		
E		BYU11101 From Molecules to Cells	GSU11005 Geology: A Beginner's Guide to Planet Earth	GSU22201 From Atoms to Rocks: An introduction to Geochemistry.	GSU22006 Physical Geography: Dynamic Earth		
		BYU11101 From Molecules to Cells	GSU11005 Geology: A Beginner's Guide to Planet Earth	GSU22201 From Atoms to Rocks: An introduction to Geochemistry.	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 successfully 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 23 rd September 2024 – 25th December 2024	SEMESTER 2 – Hilary Term 20 th January 2025 - 07 th April 2025
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
GSU11004: 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.

TR063 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), large tutorial classes (1 per week after 3rd or 4th week of semester) and elective small group tutorials (1 hr every second week).

Lecture Topics

Introduction to Physics - 1 lectures (O. Hess)
The Physics of Motion – 20-22 lectures (M. Ferreira)
Waves and Optics I – 18-20 lectures (L. Bradley)
Statistics – 6-10 lectures and labs (M. Möbius).

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.

Statistics: 6-10 lectures and labs

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 and transformation of variables in probability distributions. Linear regression analysis, method of least squares, goodness of fit (Chi squared) and plotting techniques. Introduction to programming basics in Python

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 additions, 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 provides 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 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

- 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 $\geq 35\%$ 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 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 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 $(60 \times 0.3) + (80 \times 0.1) + (25 \times 0.6) = 18 + 8 + 15 = 41\%$. 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 $\geq 35\%$ 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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PYU11P20: Physics 2

Semester 2, 10 credits

The motion and response of electrons due to electric and magnetic forces as well as 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 the quantum physics and quantum mechanics of light and electrons in atoms are the next foundational aspects of any physics education and are 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), large tutorial classes (1 per week after 3rd week of semester) and elective small group tutorials (1 hr every second week).

Lecture Topics:

- Electricity and Magnetism - 20 lectures (A. Lunghi)
- Quantum Physics - 18 lectures (P. Eastham)
- 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 how physics of matter and radiation is underpinned by quantum physics.
- 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 polarization, 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.

Quantum Physics : 18 lectures

Origins of quantum physics. Photoelectric effect. Compton Effect. De Broglie's Postulate. The Uncertainty Principle. Black body radiation and specific heat. Atomic spectra. Bohr model of the atom. Correspondence Principle. Steady-state Schrödinger equation. Particle in a 1-D box. Finite potential well. Simple harmonic oscillator. Particle at potential step. Tunnelling through a barrier. Angular momentum and spin. Quantum theory of Hydrogen atom. The periodic table. Formation of chemical bonds. Quantum information.

Gravitation and Astrophysics: 12 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 relationship. 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 $\geq 35\%$ 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 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 $(60 \times 0.3) + (80 \times 0.1) + (25 \times 0.6) = 18 + 8 + 15 = 41\%$. 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 $(60 \times 0.3) + (80 \times 0.1) + (20 \times 0.6) = 18 + 8 + 12 = 38\%$. 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 $\geq 35\%$ 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 $(50 \times 0.3) + (80 \times 0.1) + (20 \times 0.6) = 15 + 8 + 12 = 35\%$. 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: $(50 \times 0.3) + (80 \times 0.1) + (60 \times 0.6) = 15 + 8 + 36 = 59\%$ 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.

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

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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 \mathbb{R}^n .
- 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, 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.
- Re-assessment, if needed, consists of 100% exam.

Contact Details:

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Wu

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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 2×2 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 2×2 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 2.
- Continuous assessment contributes 20% towards the overall mark.
- Re-assessment, if needed, consists of 100% exam.

Contact Details:

Module Coordinators for

MAU11S02: Professor Miriam Logan

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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	Practical
Introduction and overview	Kevin Mitchell	
Section 1 Origin of Life - Cellular basis of life - Diversity of Life Forms		
1. Origins of Life	Luke O'Neill	The Diversity of Life Forms
2. Origins of Life	Luke O'Neill	
3. Cellular Basis of Life	Fred Sheedy	Liquid Handling
4. Cellular Basis of Life	Fred Sheedy	
5. Cellular Basis of Life	Fred Sheedy	Bacterial Growth & Survival
6. The Tree of Life	Alastair Fleming	
7. Bacteria	Alastair Fleming	
8. The Archaea	Alastair Fleming	
9. Fungi & Protists	Alastair Fleming	
10. Viruses	Kim Roberts	
11. Relationship Between Life Forms	Alastair Fleming	
Section 2 The Chemistry of Life		
12. Introduction to Biochemistry	Luke O'Neill	
13. Nucleotides, Amino Acids & Peptides	Luke O'Neill	Enzyme Purification (Chromatography)
14. Protein Structure	Ken Mok	
15. Protein Function	Ken Mok	
16. Enzymes	Vincent Kelly	
17. Enzymes	Vincent Kelly	Enzyme Characterisation (Kinetics)
18. Lipids & Membranes	Vincent Kelly	
19. Metabolism	Vincent Kelly	
20. Metabolism	Vincent Kelly	
21. Mitochondria & Respiration	Vincent Kelly	
22. Chloroplasts & Photosynthesis	Vincent Kelly	
Section 3 Biological Information – Genetics, Heredity & DNA		
23. Introduction to Genetics	Jane Farrar	Mendelian Genetics
24. Mendelian Genetics	Jane Farrar	
25. Linkage & recombination 1	Jane Farrar	
26. Linkage & Recombination 2	Jane Farrar	
27. Identification of DNA as Hereditary Material	Jane Farrar	
28. Quantitative Genetics	Jane Farrar	
29. DNA - Structure & Function	Kevin Mitchell	
30. Information Flow - The Central Dogma	Kevin Mitchell	
31. Information Flow - The Central Dogma	Kevin Mitchell	
32. Information Flow - The Central Dogma	Kevin Mitchell	
33. Mutation & the Consequences	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:** chloroplast, 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:

(A) **End of semester examination: 50% of module mark**

(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.

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

A student who fails to attend more than one-third (1/3) of the practical sessions cannot pass the module without completion of a supplementary practical session, or an alternative exercise in the event that a practical is not possible.

Contact Details:

Module Coordinator: Kevin Mitchell

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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 contact time.

Module Content

Lecture Topic	Lecturer	Practical
Introduction and overview	Trevor Hodkinson	
Section 1 Multicellularity and Development, Physiology, Behaviour and Neuroscience		
1. Multicellularity and Development	Paula Murphy	
2. Introduction to Development	Paula Murphy	Development and Floral Morphology
3. Embryogenesis and Morphogenesis	Paula Murphy	
4. Intercellular Communication,	Paula Murphy	
5. Pattern Formation	Paula Murphy	Physiology
6. Differential Gene Expression	Paula Murphy	
7. Form and Function	Áine Kelly	
8. Homeostasis	Áine Kelly	
9. Physiological Regulation	Áine Kelly	
10. Pre-neuroscience History of Ideas of Mind & Brain	Tomas Ryan	
11. Fundamentals of Nervous System Structure and Function	Tomas Ryan	
12. Introduction to the Biology of Memory Storage	Tomas Ryan	
Section 2 Evolution: Adaptation, Populations and Biodiversity		
13. History of life	Trevor Hodkinson	First Life
14. Selection/modern synthesis	Trevor Hodkinson	
15. Species	Trevor Hodkinson	Diversity of Life
16. Speciation	Trevor Hodkinson	
17. Extinction	Trevor Hodkinson	Evolution
18. Phylogeny	Trevor Hodkinson	
19. Genetic Basis of Selection	Aoife McLysaght	Species Diversity Evolution & Modularity
20. Genetic Basis of Evolution 1	Aoife McLysaght	
21. Genetic basis of Evolution 2	Aoife McLysaght	
22. Human Evolution	Aoife McLysaght	
Section 3 Ecology and Environment		
23. Species	Jay Piggott	
24. Species - Conservation	Jay Piggott	Biodiversity & Ecosystems Services
25. Trophic Cascades and Rewilding	Jay Piggott	
26. Constructing Ecosystems and Conservation	Jay Piggott	
27. Urban ecology	Jay Piggott	
28. Ecosystem Services and Natural Capital	Jay Piggott	Biological Environmental Systems
29. Global Ecology and Climate Change	Richard Nair	
30. Biomes, Niches	Richard Nair	
31. Biomes and Global Productivity	Richard Nair	
32. Biomes and Biogeochemical Cycles	Richard Nair	
33. Desiccation Resistance and Space Travel	Richard Nair	

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:** extinction 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**

(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.

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

A student who fails to attend more than one-third (1/3) of the practical sessions cannot pass the module without completion of a supplementary practical session, or an alternative exercise in the event that a practical is not possible.

Contacts details:

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CHU11101: General and Physical Chemistry

Semester 1, 10 credits

Capping

If a student is required to be reassessed in the module, a capped mark of 60% will apply to any component that is reassessed in this chemistry module.

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)	<p>Introduction to General Chemistry</p> <ul style="list-style-type: none">• 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.

	<p>General Chemistry: Structure, Bonding, and Periodicity</p> <ul style="list-style-type: none"> • 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)	<p>Introduction to Physical Chemistry</p> <ul style="list-style-type: none"> • 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

	<ul style="list-style-type: none"> • Solutions: liquids in liquids, gases in liquids, solids in liquids • Thermodynamics of solvation • Colligative properties
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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).

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CHU11102: Introduction to Inorganic and Organic Chemistry

Semester 2, 10 credits

Capping

If a student is required to be reassessed in the module, a capped mark of 60% will apply to any component that is reassessed in this chemistry module.

Content Layout

Teaching Week	Topic
1-8 (28 L)	<p>Introduction to Organic Chemistry</p> <ul style="list-style-type: none">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 <i>E-Z</i> 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

	<p>group, keto-enol tautomerism, the enolate anion, resonance, haloform reaction, aldol condensation.</p> <ul style="list-style-type: none"> • 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)	<ul style="list-style-type: none"> • 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 bipyramid; 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

	<ul style="list-style-type: none"> • Consequences and applications of orbital splitting: Electronic configurations of metal complexes; crystal field 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.
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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 (25% of the final mark) and a 3 h examination paper (75% of the final mark).

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GSU11004: 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: 100% continuous assessment via in-course tests and assignments.

Module Website: Blackboard

Contact Details:

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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: 50% examination; 50% continuous assessment via in-course tests and assignments.

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

Contact Details:

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Geography Department

Executive Officer:

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Geology Department

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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.

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/>

Laboratory Practicals, Field courses and Tutorials

The primary function of laboratory practicals, compulsory field courses and tutorials is to equip students with the skills and knowledge necessary to be successful at sophister level in their chosen moderatorship. Therefore, they are an extremely important part of the student educational experience in Science. The learning outcomes for these components are intrinsically linked with the physical actions of being present. Students who do not attend at least 2/3 of the compulsory sessions in a module will be returned as “non-satisfactory attendance and may be excluded from taking their exams: see section below.

Coursework/assignments

Students must complete and submit all coursework, laboratory write ups, field course notes in full by the published submission date. Deductions for late submission will be applied as follows:

Biology – 10% reduction from final grade per week

Chemistry – 10% for the first 24 hours and 5% ever day after that

Geoscience – 10% reduction from final grade per week

Module handbooks will detail penalties for late submission of individual pieces of continuous assessment.

It is therefore essential, that students who think they will not be in a position to meet a certain deadline, contact the module Coordinator or Course Director before the due date. We recognise that there are times when students will struggle with deadlines, and problems identified at the time are more easily dealt with than retrospectively when assignments start piling up.

Module coordinators/Course Director details can be found in the Blackboard modules or in the relevant handbooks available for download from the Science webpage: <https://www.tcd.ie/science/undergraduate/>

Absence through illness:

Where a student misses an assigned laboratory/field course/compulsory tutorial class through illness, they must **(a)** submit an absence report and upload a med cert via the Science Absence form: <https://forms.office.com/Pages/ResponsePage.aspx?id=jb6V1Qaz9EWAZJ5bgvvlK2pn-Bcn6aBJpJezeqwuYapUMkpaU1E5SDY5TDZaTUhYU01PMlhBV0kxSyQIQCN0PWcu> **on the day of their return to College** and **(b)** inform the laboratory practical supervisor of their absence at the earliest opportunity and certainly at the next session.

Note: submission of a medical certificate does not automatically initiate excusal from an activity. The student must obtain excusal from the module coordinator or Course Director after they have submitted a medical cert.

Other absences:

Students who have sports commitments to the College should supply confirmation from the appropriate committee to the Module Coordinator/Course Director well in advance of any event.

Students who anticipate that their sporting commitments may necessitate more than an occasional absence from College (e.g., Sports Scholars etc.) should discuss their situation with their tutor and the Associate Dean of Undergraduate Science Education (ADUSE).

Students who have unexpected family commitments should request excusal from the Module Coordinator/Course Director. Excuses for absence presented after the event, will not be accepted.

Vacations/Holidays/Weddings during teaching term

Students who are absent from College during teaching term for planned vacations/holidays/weddings etc. must ask the Senior Lecturer, through their tutor, for permission to be absent from college. No special accommodations will be made for such students. No replacement tutorials, laboratory/field courses will be scheduled, and no lecture material will be recorded. The onus in such cases lies with the student to catch up on the worked missed.

The general regulations outlined above will apply however, individual cases will be reviewed on their own merits.

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.

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>

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, 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/>

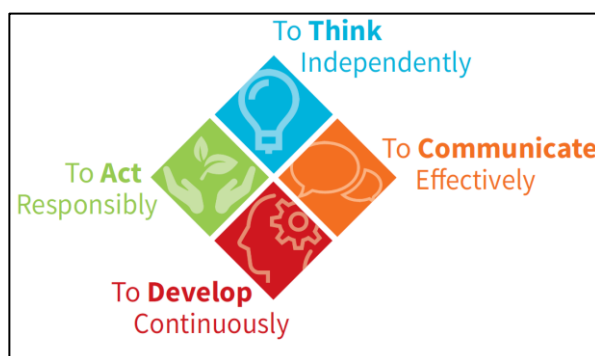
For information on Registration, Fees, Grants, ID Cards etc. visit the Academic Registry (AR) in the Watts Building or the visit the AR website: <https://www.tcd.ie/academicregistry/>

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 programme of study.

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

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

Dates to Note:

Fresh Orientation:	16 th September to 20 th September 2024
Semester one term dates:	09 th September to 29 th November 2024
Study Week Semester 1:	21 st to 25 th October 2024
Semester one examinations:	09 th December to 13 th December 2024
Semester two term dates:	20 th January 2024 to 11 th April 2025
Study week semester 2:	03 rd to 07 th March 2025
Semester two examinations:	22 nd April to 25 th April 2025

TEACHING TERM DATES 2024-2025					
Michaelmas Term Monday 9 September - Friday 29 Nov 2024			Hilary Term Monday 20 January 2025 - Friday 11 April 2025		
Teaching wk. 1	Week 03	09 Sept – 13 Sept	Teaching wk. 1	Week 22	20 Jan - 24 Jan
Teaching wk. 2	Week 04	*16 Sept - 20 Sept	Teaching wk. 2	Week 23	27 Jan – 31 Jan
Teaching wk. 3	Week 05	**23 Sept - 27 Sept	Teaching wk. 3	Week 24	*03 Feb - 07 Feb
Teaching wk. 4	Week 06	30 Sept – 04 Oct	Teaching wk. 4	Week 25	10 Feb - 14 Feb
Teaching wk. 5	Week 07	07 Oct - 11 Oct	Teaching wk. 5	Week 26	17 Feb - 21 Feb
Teaching wk. 6	Week 08	14 Oct – 18 Oct	Teaching wk. 6	Week 27	24 Feb – 28 Feb
Study week	Week 09	21 Oct - 25 Oct	Study week	Week 28	03 Mar - 07 Mar
Teaching wk. 8	Week 10	*28 Oct - 01 Nov	Teaching wk. 8	Week 29	10 Mar - 14 Mar
Teaching wk. 9	Week 11	04 Nov - 08 Nov	Teaching wk. 9	Week 30	*17 Mar - 21 Mar
Teaching wk. 10	Week 12	11 Nov - 15 Nov	Teaching wk. 10	Week 31	24 Mar - 28 Mar
Teaching wk. 11	Week 13	18 Nov - 22 Nov	Teaching wk. 11	Week 32	*31 Mar - 04 Apr
Teaching wk. 12	Week 14	25 Nov – 29 Nov	Teaching wk. 12	Week 33	07 Apr - 11 Apr

* Orientation week for new entrants

** Teaching begins for all Junior Fresh Students

October bank holiday – Monday 28th October 2024

February bank holiday – Monday 3rd February 2025

St Patrick's Day - Monday 17th March 2025

Contacts: TR063: Physical Sciences

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

Ph: 01 896 1675

E-mail: dowlingu@tcd.ie

Science Course Office

Professor Fraser Mitchell

Associate Dean of Undergraduate Science Education

Ph: 01 896 2025

E-mail: fraser.Mitchell@tcd.ie

Ann Marie Brady

Science Course Office Manager

Ph: 01 896 2829

E-mail: ennisa@tcd.ie

Ms Helen Sherwin Murray

Administrative Officer

Ph: 01 896 2799

Email: helen.sherwinmurray@tcd.ie

Ms. Andressa dos Santos Melo

Executive Officer

Ph: 01 896 1970

E-mail: dossanta@tcd.ie

Ms. Romarey Segura

Executive Officer

Ph: 01 896 2022

E-mail: segurar@tcd.ie

Appendix 1: General Information

ITEM	REFERENCE/Source
General Regulations	<p>Calendar, Part II - General Regulations and Information, Section II, Item 12: https://www.tcd.ie/calendar/undergraduate-studies/general-regulations-and-information.pdf</p> <p>Calendar, Part III, General Regulations, Section 1.20 https://www.tcd.ie/calendar/graduate-studies-higher-degrees/complete-part-III.pdf</p> <p>Attendance Requirements: Calendar, Part II, General Regulations and Information, Section II, Items 17-23 Calendar, Part III, General Regulations and Information, Sections 1.23; 2.11; and 3.2</p> <p>Absence from Examinations Calendar, Part II, General Regulations and Information, Section II, Item 35 Link here for more information assess-nonsub-absence-sep2020.pdf (tcd.ie)</p> <p>Academic Integrity: https://libguides.tcd.ie/academic-integrity</p>
General Information	<p>Timetable are available via my.tcd.ie portal: https://my.tcd.ie/urd/sits.urd/run/siw_lgn</p> <p>Blackboard: https://tcd.blackboard.com/webapps/login/</p> <p>Academic Registry: https://www.tcd.ie/academicregistry/</p> <p>Data Protection: https://www.tcd.ie/info_compliance/data-protection/student-data/</p> <p>Dignity & Respect Policy Dignity and Respect Policy - Equality Trinity College Dublin (tcd.ie)</p>
Foundation Scholarship	<p>Foundation and Non Foundation Scholarship: Calendar, Part II www.tcd.ie/calendar/undergraduate-studies/foundation-and-non-foundation-scholarships.pdf</p> <p>Science Foundation Scholarship information sheet: TR063-foundation-scholarship-information-20-21.pdf (tcd.ie)</p>
Teaching and Learning	<p>Academic Policies: https://www.tcd.ie/teaching-learning/academic-policies/</p> <p>Student Learning and Development: https://www.tcd.ie/Student_Counselling/student-learning/</p> <p>Student Complaints Procedure https://www.tcd.ie/about/policies/160722_Student%20Complaints%</p>

Appendix 1: General Information

	<p>20Procedure_PUB.pdf</p> <p>Dignity & Respect Policy https://www.tcd.ie/equality/policy/dignity-respect-policy/</p> <p>Student Evaluation and Feedback: https://www.tcd.ie/teaching-learning/quality/quality-assurance/evaluation.php</p> <p>Academic Integrity: https://libguides.tcd.ie/academic-integrity</p> <p>National Framework for Qualifications: National Framework of Qualifications Quality and Qualifications Ireland (qqi.ie)</p>
Student support	<p>Student Support Services: https://www.tcd.ie/students/supports-services/</p> <p>Student Services Booklet: Student Services Handbook.pdf (tcd.ie)</p> <p>Senior Tutor & Tutorial Service www.tcd.ie/students/assets/pdf/Student%20Services%20Booklet%20(web%20version).pdf</p> <p>Graduate Studies https://www.tcd.ie/graduatestudies/</p> <p>Mature Student Office https://www.tcd.ie/maturestudents/</p>
Co-curricular activities	<p>Central Societies Committee: https://www.trinitysocieties.ie/</p> <p>DUCAC: Dublin University Central Athletic Club - Trinity Sport - Trinity College Dublin (tcd.ie) Student Sport - Trinity Sport - Trinity College Dublin (tcd.ie)</p>
Information on TCDSU, Including student representative structures	<p>TCDSU https://www.tcdsu.org/</p>
Emergency Procedure	<p>In the event of an emergency, dial Security Services on extension 1999. Security Services provide a 24-hour service to the college community, 365 days a year. They are the liaison to the Fire, Garda and Ambulance services and all staff and students are advised to always telephone extension 1999. (+353 1 896 1999) in case of an emergency.</p>

Appendix 1: General Information

Should you require any emergency or rescue services on campus, you must contact Security Services. This includes chemical spills, personal injury or first aid assistance.

It is recommended that all students save at least one emergency contact in their phone under ICE (In Case of Emergency).

NOTE: All of the information contained in this booklet is accurate at 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.