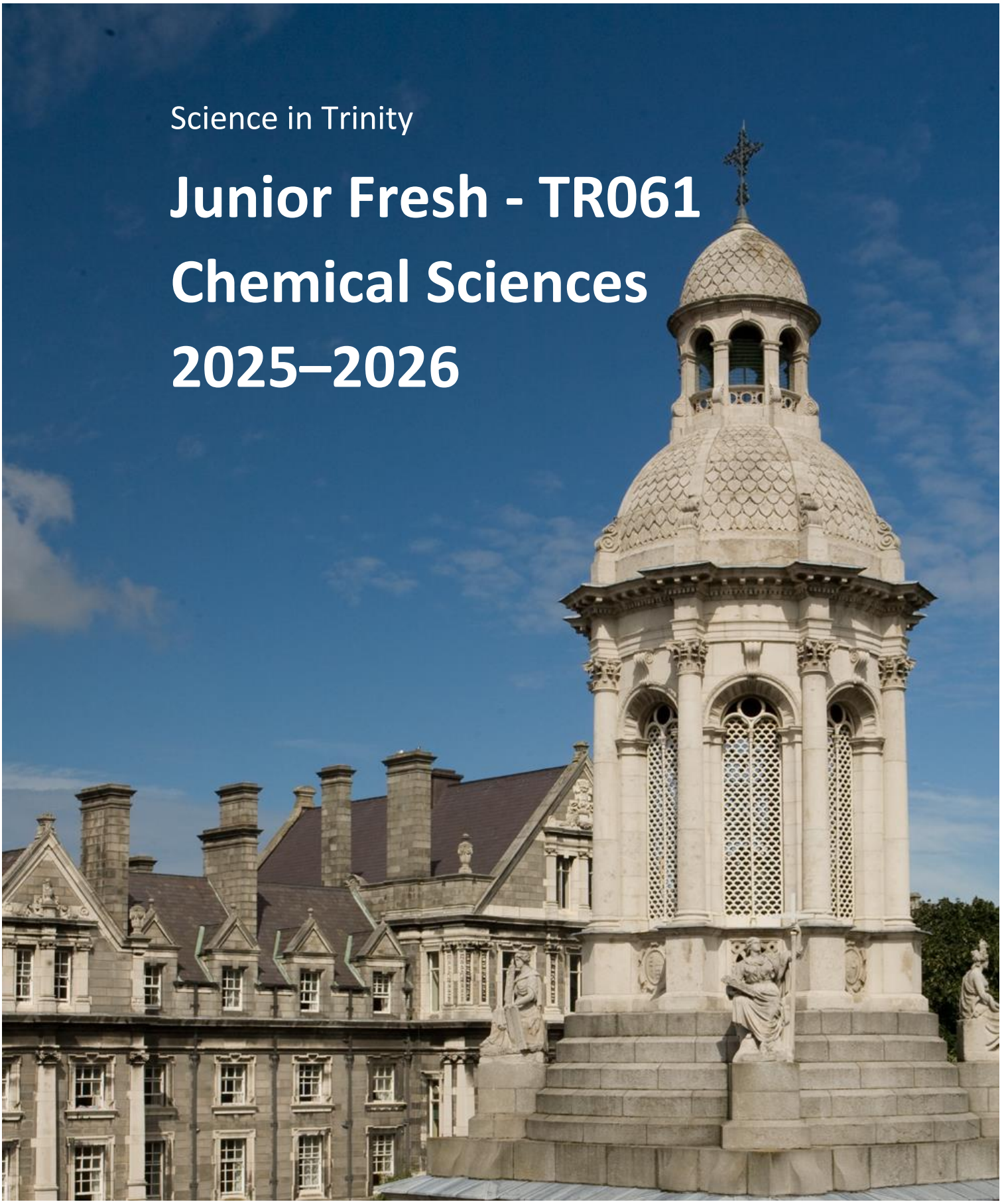
Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin



Science in Trinity

Junior Fresh - TR061 Chemical Sciences 2025–2026

Contents

TR061: Chemical Sciences Introduction

Welcome to your first year in the TR061 Chemical Sciences degree programme! The Chemical Sciences play a central role among the sciences. Chemistry is the study of matter, that is, the composition, structure and properties of substances and the changes they undergo. Life on Earth owes its origin to a series of these chemical changes. An understanding of molecular structures and properties and how to tailor those through chemical changes is critical in many scientific fields and underpins important technologies we rely on every day.

Chemistry is a dynamic discipline that interfaces constantly with other disciplines. Chemists enjoy analysing, synthesising, and designing new compounds and materials to solve modern societal, medical and environmental challenges. Chemists also engage in the creative process of developing new models and theories to explain the workings of our natural world. As part of your degree, you will learn core foundational principles of the chemical sciences but will also be introduced to new areas of chemistry at the frontiers with biology, physics, medicine and computer sciences. Importantly, we will help you acquire proficiency in technical methodologies while supporting the development of effective professional communication skills that are essential for your future career, whether you aspire to becoming a practicing chemist in industry or academia, or to working in business, consultancy or social enterprises.

Formal Chemistry teaching in TCD commenced in August 1711 as part of the new School of Medicine and is now delivered by the staff in the School of Chemistry. The TR061 Chemical Sciences is a new and highly flexible 4-year degree programme that allows you to tailor the focus of your degree through selection of module combinations over the course of your entire undergraduate education. Entry into TR061 gives you the option to choose amongst five Moderatorships as exit routes, namely:

- Chemistry.
- Chemistry with Biosciences.
- Chemistry with Molecular Modelling.
- Medicinal Chemistry.
- Nanoscience.

Junior Fresh module choices recommended and/or required for completing each of the above Moderatorships are discussed in this handbook.

Staff, Research and Facilities in the School of Chemistry

The School of Chemistry currently has 24 academic staff and 10 technical staff. The School has an active research programme, with approximately 100 postgraduate students and postdoctoral researchers. They study a range of subjects such as organic, inorganic, organometallic, physical, theoretical, medicinal, analytical, material, polymer, environmental, and supramolecular chemistry. Research income is earned from national, international and commercial sources and the School has held grants in all relevant research programmes funded by the EU. The College also fosters an interdisciplinary approach to

research, with members of the School having strong links with colleagues in the physical, technological and biological sciences both within College, nationally and internationally.

The main chemistry building includes two lecture theatres and four research laboratories. A suite of teaching laboratories (the Cocker laboratories) provides facilities for the teaching of preparative inorganic and organic chemistry. The Sami Nasr Institute for Advanced Materials (SNIAM) provides ca. 1500 m^2 of accommodation for the School of Chemistry. This includes a Physical Chemistry teaching laboratory and six research laboratories to house ca. 40 researchers. Computational Chemistry research is housed in the Lloyd Institute on a multidisciplinary computational-science floor comprising researchers from Mathematics, Physics, Chemistry and High-Performance Computing. In addition, chemists play an important role in interdisciplinary research taking place in TCD's research institutes: (i) the Nanoscience Institute – The Centre for Research on Adaptive Nanostructures and Nanodevices (CRANN), and (ii) the Trinity Biomedical Sciences Institute (TBSI).

As part of your degree, you will gain exposure to open ended research thanks to the support of academic staff who work at the cutting-edge of science and through access to state-of-the-art instrumentation. The school is well equipped for its research activities, having Agilent 800 and 400 MHz, and Bruker 600 and 400 MHz high-field multi-nuclear NMR, FTIR, dispersive IR and UV-visible spectrometers, high performance liquid (HPLC) and gas (GC) chromatography equipment, a Rigaku Saturn 724 Diffractometer and Bruker SMART APEX single crystal and Siemens D500 powder diffractometers, Micromass LCTTM (TOF) mass spectrometer, thermogravimetric analysis and differential scanning calorimetry, dynamic light scattering, several spectrofluorometers for steady-state and time-resolved fluorescence measurements, circular and linear dichroism, and a large range of wave generators and potentiostats for cyclic voltammetry.

Professor Mike Southern

Director, TR061 Chemical Sciences

TR061 Chemical Sciences overview session and module selection

All Chemical Sciences students **must** attend their introductory session on **16th September 2025, in the Chemistry Large Lecture Theatre from 11.00 to 12.00** hrs, where they will receive important course information and guidance on choosing the correct modules for the pathway they wish to follow. Students will also meet many of the Academic members of staff who will be delivering lectures and running labs during the year.

In the Junior and Senior Fresh years, TR061 students complete a course of study that will qualify them for a place in one of the following Moderatorships after their Senior Fresh year:

- Chemistry (C)
- Chemistry with Bioscience; (CB)
- Chemistry with Molecular Modelling (CMM)
- Medicinal Chemistry (MC)
- Nanoscience (N)

The curriculum in the five Moderatorships is tailored to offer a general Chemistry degree (C), a degree focusing on the chemicals and chemical reactions involved in biological processes (CB), a degree with an emphasis on computational methods in chemistry, (CMM), a degree focusing on the synthesis and applications of small drugs for medicinal purposes (MC) and a degree with emphasis on the chemistry and physics of advanced materials and nanomaterials (N). We recommend discussing with the academic staff available during orientation week which of these Moderatorships is best aligned with your current interests. Importantly, students should ensure that module choices over JF and SF years fulfil the requisites to apply for a place in the preferred Moderatorship(s).

The pattern choices available prepare the student through a different balance in the content of their foundation courses. The credits dedicated to each discipline, depending on the module pattern choice, are outlined below:

	Pattern JF.1	**Pattern JF.2**
Core credits	20 ECTS Chemistry 20 ECTS Maths	20 ECTS Chemistry 20 ECTS Maths
Approved credits	10 ECTS Biology 10 ECTS Foundation Physics	20 ECTS Physics

The Table below summarises which JF module patterns fulfil the requisites to apply for each of the five Moderatorships.

Chemistry (C)	Chemistry with Biosciences (CB)	Chemistry with Molecular Modelling (CMM)	Medicinal Chemistry (MC)	Nanoscience (N)
Pattern JF.1 OR Pattern JF.2	Pattern JF.1	Pattern JF.1 OR Pattern JF.2	Pattern JF.1	Pattern JF.2

Studies in your SF year of TR061 will also allow for a choice of open modules; however, it is important to note that open SF modules will require the student to have completed the corresponding pre-requisites:

- **The BYU11101 module is a prerequisite to Biology modules in the SF year.**
- **The PYU11P10/P20 modules are prerequisites to Physics modules in the SF year.**

In their Junior Fresh year, all students must take the 4 core modules for a total of 40 ECTS (20 ECTS per semester) as follows:

Code	Module Title	Semester	ECTS
CHU11101	General and Physical Chemistry	1	10
CHU11102	Introduction to Inorganic and Organic Chemistry	2	10
MAU11S01	Mathematics for Scientists 1	1	10
MAU11S02	Mathematics for Scientists 2	2	10

Students will choose 2 additional modules among those approved for the TR061 programme, for a total of 20 ECTS (10 ECTS per semester). The following two module patterns are available to all students in TR061:

Code	Module Title	Semester	ECTS
Pattern JF.1 (fulfils requisites for Moderatorships in C, CB, CMM, MC)			
BYU11101	From Molecules to Cells	1	10
PYU11F20	Foundation Physics for Life and Earth Scientists 2	2	10
Pattern JF.2 (fulfils requisites for Moderatorships in C, CMM, N)			
PYU11P10	Physics 1	1	10
PYU11P20	Physics 2	2	10

Semester Structure

TR061: CHEMICAL SCIENCES

CORE MODULES (mandatory) – 20 credits per semester.

SEMESTER 1 – Michaelmas term (15th September – 05th December 2025)	**SEMESTER 2 – Hilary Term (19th January – 10th April 2026)**
CHU11101: General and Physical Chemistry	CHU11102: Introduction to Inorganic and Organic Chemistry
MAU11S01: Mathematics for Scientists 1	MAU11S02: Mathematics for Scientists 2

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

BYU11101: From Molecules to Cells	PYU11F20: Foundation Physics for Life and Earth Scientists
OR	
PYU11P10: Physics 1	PYU11P20: Physics 2

Module Choice Form

- Module choices will be made online. **Please note that choices you make in Junior Fresh year may influence your choices in the Senior Fresh year.**
- Please read this booklet carefully, paying particular attention to the information on pages 4 and 5, and then go to: **https://forms.office.com/r/JntduYgyLb** to select your modules. If you feel that you need assistance with your choices, please contact us at jfsco@tcd.ie, and we will be happy to help. Please note that the online module choice forms will **not** open until **12.00 hrs on Tuesday, the 16th of September,** after the introductory session. **Forms must be submitted by 12.00 hrs on Wednesday, the 17th of September 2025.**
- Please note that if you do not submit your open module choices, you will not have a full timetable, nor will you receive up-to-date module information via Blackboard.

Change of open modules

If, after a couple of weeks, a student feels that they have perhaps made the wrong choice of open module, they should seek **advice immediately** from a Tutor, Course Director or the Science Course Office. It may be possible to change from one module to another within your course, subject to permission from the Associate Dean of Undergraduate Science Education. Once a decision has been made to change modules, it should be done **quickly** - it can be difficult to try to catch up with work in a new module when more than two or three weeks of lectures have been missed. Change of module forms are available from the Science Course Office.

TR061 Chemical Sciences - Core Modules

CHU11101: General and Physical Chemistry

Semester 1, 10 credits

Rationale and Aims

To provide a general introduction to chemistry and physical chemistry and equip 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 the chemistry of liquids, solids, and solutions.

Content Layout

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

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

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

Reading list/ Indicative Resources

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

Methods of Teaching and Student Learning

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

Learning outcomes

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

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

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

Assessment details:

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

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

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

Contact Details

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CHU11102: Introduction to Inorganic and Organic Chemistry

Semester 2, 10 credits

Content Layout

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

	reduction of the carbonyl group, keto-enol tautomerism, the enolate anion, resonance, haloform reaction, aldol condensation. • Carboxylic acids, acid strength, carboxylate anions, esters, acid halides, acid anhydrides, amides, emphasis on electrophilic nature of the carbonyl group, mechanism of esterification and hydrolysis.
9-12 (14 L)	• Introduction to Inorganic Chemistry 1 • This section of the module covers an introduction to inorganic chemistry, with emphasis on bonding, molecular orbital treatment of bonding, and an introduction to coordination chemistry. • Introduction to Molecular Orbital Theory (7 L) • Atomic orbitals (s,p,d) as wave functions; their representation as enclosed boundary surfaces and as radial distribution functions. The relationship of these ideas to the Bohr model for atomic hydrogen. Relative energies of these orbitals; orbital angular momentum in non-hydrogen-like atoms; penetration and shielding. • Hybridisation of atomic orbitals and the hybrids associated with various geometries; VSEPR treatment of molecular structures. • Bonding as the linear combination of atomic orbitals, including non-bonding and anti-bonding interactions. Labelling of molecular orbitals as sigma, pi (g or u), molecular orbital diagrams of homonuclear diatomic molecules of the first and second row of the Periodic Table. Mixing of molecular orbitals and its effect on the relative energies of the resulting molecular orbital diagram. Molecular orbital approach for simple molecules including H_2O, BeH_2 and BCl_3. Reactivity of CO in terms of the molecular orbital energy diagram for this molecule. Appreciation of the Molecular Orbital basis of the spectrochemical series. • Introduction to Coordination Chemistry • Brief introduction - why study metal complexes? • What is a metal complex? Overview of concepts and definitions: Lewis Acid-base concept. • Formation and stability of metal complexes: Complex formation and dissociation; cumulative stability constants and trends; the 'chelate effect'; factors affecting stability. • Classification of common ligands: Donor atoms and functional groups. Multidentate and chelating ligands; stereochemistry and formation of chelate rings.

	• Stereochemistry of metal complexes. Coordination numbers 2-6 and geometry of metal complex; square planar, tetrahedral; trigonal bi-pyramid; square based pyramid; octahedral; distortion of geometries. • Electronic structure and properties of transition metal complexes: Ionic vs. covalent bonding models; crystal field theory; energy level diagrams in tetrahedral - octahedral fields. • 18-electron rule , Molecular Orbital Diagrams for Octahedral Complexes, M-L σ and π bonding • Consequences and applications of orbital splitting: Electronic configurations of metal complexes; crystal filed stabilization energies (CFSE); Factors effecting Delta; spectrochemical series; HS and LS configurations; magnetic properties and the spin-only formula. • Electronic spectra of metal complexes: UV-vis. Spectra; interpretation of data; Laporte and spin selection rules; extinction coefficients and wavelength; Jahn-Teller effect.

Reading list/ Indicative Resources

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

Methods of Teaching and Student Learning

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

Learning outcomes

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

- Identify and explain bonding, hybridisation and mechanisms.
- Describe and explain the chemistry of functional groups (alkanes, alkenes and alkynes, aromatics, alkylhalides, alcohol, aldehydes, ketones and amines) and their applications.

- Analyse and discriminate between mechanisms in terms of the inherent reactivity/polarisation etc. of the two reaction components.
- Identify and classify chiral centres in organic molecules.
- Understand particle wave duality, the contribution of quantum mechanics to understanding atomic and molecular orbits, formation of bonds and how molecular orbitals can be derived using atomic orbitals.
- Discuss Lewis Acid-Base concept and classify different ligands.
- Understand the chelate effect and factors which affect metal complex stability.
- Analyse common geometries and distortion.
- Explain different bonding models and Crystal Field Theory.
- Predict and explain d-orbital splitting in transition metal complexes and its effects on the geometry and electronic properties.
- Calculate crystal field stabilization energies (CFSE) and high-spin and low-spin configurations.
- Interpret extinction coefficients and selection rules in understanding electronic spectra of complexes.

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).

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

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

Contact Details:

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MAU11S01: Mathematics for Scientists 1

Semester 1, 10 credits

Contact hours:

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

Learning outcomes:

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

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

Module content:

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

Recommended reading list:

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

Assessment details:

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

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

Contact Details:

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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 2x2 matrices, with applications to differential equations.
- Derive probability distributions in some simple cases.
- Solve problems involving the binomial distribution.
- Calculate percentage points for continuous distributions such as the normal, chi-squared, and student's t-distribution.
- Compute confidence intervals for the mean and standard deviation.

Module content:

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

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

Recommended reading lists:

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

Module Prerequisite:

MAU1S001 Mathematics for Scientists 1 (First Semester)

Assessment details:

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

Contact Details:

Module Coordinators for MAU11S02

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TR061 Chemical 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. Online learning resources, assignments, submission instructions and information concerning the day-to-day running of the module will be published in Blackboard. Sixty-five hours contact time.

Module Content

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

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

Lecture Content:

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

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

Recommended Textbook

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

Assessment Details:

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

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

Further Information

Plagiarism

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

Late work

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

Missed classes/assessments

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

Non-satisfactory reports

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

Compensation

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

Contact Details:

Module Coordinator: Kevin Mitchell	kevin.mitchell@tcd.ie Phone: 01 8963067
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PYU11F10: Foundation Physics for Life and Earth Sciences

Semester 1 or Semester 2, 10 credits

Foundation Physics for the Life and Earth Sciences is a foundation module (10 credits) in physics.
It is available as an approved 10 credit module for TR060 and TR062 students, all of whom are taking Maths, Stats, & Computation (10 credits); as well as for TR061 students (if not taking Physics 1 or Physics 2) who take both Mathematics 1 (10 credits) and Mathematics 2 (10 credits). It is available in both semesters for TR060 (but cannot be taken twice); it is only available in semester 2 for TR061 or TR062 students.

Module Content:

This foundation module comprises lectures, practical work and tutorials, providing an introduction to: physics of motion, biomechanics, physics of hearing and seeing, electricity, magnetism and bioelectricity, radioactivity, nuclear physics and related medical applications, heat, pressure, as well as fluids and their biological, geological and medical applications.

Module Learning Outcomes:

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

- Demonstrate the application of Classical Physics within the biomedical and earth sciences
- Connect the study of wave phenomena and electromagnetism with ultrasound diagnostics and vision.
- Relate basic knowledge of atomic and nuclear physics to radiation diagnostics and therapy, and to geological applications.
- Prepare a brief report, including error analysis, on a simple physical experiment.
- Through homework: (i) identify the appropriate concepts, principles, and relations that apply to the problem; (ii) provide a reasonable and appropriate explanation of why they apply; and (iii) solve physics problems at a foundation level.

Module Structure:

Contact Hours: 42 lectures/tutorials, three-hour practical laboratories, online homework.

Module Personnel: Lecturers: Prof. Lewys Jones; Prof. Martin Hegner; Prof. Matthias Möbius

Summary of Practicals:

In the Foundation Physics for Earth and Life Sciences students complete a minimum of three practical experiments, including from those experiments available at the bench in the laboratory during the semester. The emphasis in these practicals whether at home or in the laboratory is on learning to make physical measurements, record keeping in scientific laboratory notebooks, estimating uncertainties in measurements, while using these estimates in analysing data in order to make a quantitative measurement of a physical property. Differing students will attempt a differing set of experiments selected from those

available. There may also be a differing availability of laboratory experiments on the bench in both semesters. Students are required to record all data and information related to their experiments in a hardback practical laboratory notebook which is assessed. At-home physics practical experiments may be assigned and evaluated together with the laboratory based practicals.

Laboratory Practicals:

Experiments are selected from among but are not limited to: Pendulum, Thin Lenses, Density and the Principle of Archimedes, Surface Tension, Electrical Resistance, Collisions and Momentum Transfer, Resonance Tube, Leslie's Cube, Geiger Counter, and Photoelectric Effect among others.

Assessment of practical experiments:

All student's physics experiments are assessed through both online and submission of written experimental reports and through an at-the-bench laboratory notebook assessment. These reports and notebooks must include and require a documented complete data analysis, description and concise report of the outcomes of the experiment, and any inferences or conclusions that can be drawn from the outcome.

Reading List:

There is required reading and textbook for this course is an online e-Book, "Physics: Principles with Applications" by Giancoli from Pearson publishers. The e-Book includes access to the online homework platform used for assessment, and purchasing this bundle is a requirement for enrolling on this course. The School of Physics has negotiated a group-discount for this book and details of how to obtain this discount will be shared with students after enrolment.

Online Assignments:

Online assignments are submitted through the online homework platform associated with the "Physics: Principles with Applications" by Giancoli. The electronic access is associated with the required text book and details of how to register once you have purchased the e-Book will be shared after enrolment.

Methods of Teaching and Student Learning:

A mixture of lectures, hands-on laboratory practicals, lecture demonstrations and weekly on-line assignments based on both numerical and conceptual questions from the textbook 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 a firm introduction to the process of physical measurements, as well as an introduction to estimations of uncertainty (error) and propagation of errors as applied to physics experiments. Each experiment has its own specific learning outcomes and is structured to further clarify concepts met in the textbook and lectures to reinforce 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.

Finally, a number of lecturers use class-based polling of student responses to questions using the available "clicker" technologies.

Methods of Assessment:

Assessment is by a combination of examination and continuous assessment and will include multiple choice tests (MCQs) examination paper; laboratory and at-home assessed practical work; and online tutorial homework assignments.

Module website: See links at: http://www.tcd.ie/Physics/study/current/undergraduate/

Contact Details:

Foundation Physics Course Coordinator:
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Junior Fresh Physics Coordinator:
Prof. Matthias Möbius — mobiusm@tcd.ie
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Ms Una Dowling

PYU11P10: Physics 1

Semester 1, 10 credits

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

Structure and contact hours.

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

Lecture Topics

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

Learning outcomes

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

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

Syllabus

Introduction to Physics: 1 lecture

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

The Physics of Motion: 20-22 lectures

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

Waves and Optics I: 18-20 lectures

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

Tools for Physics (inc. Statistics): 14 lectures

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

Methods of Teaching and Student Learning:

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

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

Large tutorial groups of the order of 20-30 students meet to discuss with lecturers the solutions to specific assigned physics problems, discussing the approaches, methods, mathematics, and physics of the correct solutions. Video resources comprising short videos on physical intuition, thinking, problem solving or physics approaches as well as some

relevant mathematical techniques will be made available online will supplement lecture material and will include some additional short physics topics from your textbooks to illustrate techniques. In addition, students may be invited to attend small group tutorials – in groups of 6-8 – which would meet with assigned academics every second week to introduce and practice the concepts of physics problem solving and the use of mathematics in physics and to develop physics insight in the students. These small group tutorials try to emphasise peer learning within the tutorial format, and these problem-solving activities provide an additional opportunity for the assigned academic to assess understanding and gauge the knowledge level of the students.

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

Methods of Assessment and Weighting

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

Progression regulations applying to Physics modules and accredited Physics programmes.

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

A) Minimum mark requirement and Qualified Fails in Fresher years

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

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

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

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

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

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

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

- In reassessments, a cap (maximum mark) of 60% will apply to
  - i) all the reassessed components for core Junior Fresh and Senior Fresh Physics modules delivered as part of the Physical Sciences and Theoretical Physics courses (and available to students in the Chemical Sciences course as Open modules) which are listed above in A(i).
  - ii) all reassessed components of all modules in the Sophister years (except Trinity Electives) within the four accredited degree programmes Physics, Physics & Astrophysics, Nanoscience, and Theoretical Physics, irrespective of the owning School. Accreditation of these degree programmes is by the Institute of Physics (IoP).
  - The abovementioned capping will apply to re-assessed components of the affected School of Physics (PYU code) modules irrespective of the degree stream of the student, registration or visiting student status, or year of first admission. The Sophister PYU modules are not available to any other non-accredited Sophister degree programmes.
  - Re-assessment capping does not apply to deferred 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*0.3) + (80*0.1) + (25*0.6) = 18+8+15 = 41%. This however is a Qualified Fail as they obtained a mark <30% in their examination. They do not pass the module and must present for reassessment.*
    - *Student B in their Semester 2 JF module obtains a mark of 60% in their labs, 80% in their assignments but 20% in their examination with weightings of 30%, 10% and 60% respectively. Their module mark is thus (60*0.3) + (80*0.1) + (20*0.6) = 18+8+12 = 38%. This is a Fail mark in the module, and this mark is not eligible to be a Qualified Pass as this student obtained a mark <30% in their examination. They do not pass the module and must present for reassessment.*
      Compensation rules otherwise apply to module marks >=35% provided 50 credits of modules have achieved a pass mark and no more than 10 credits of module are equal to or above 35% and none are below 35%, provided that the annual average mark is 40% or higher.
- Example of a qualified fail at the **second attempt**:
    - *If either Student A or Student B above obtained those marks in their reassessment examination at their second attempt, i.e. obtaining a Qualified Fail or being ineligible for a Qualified Pass, they must repeat the year. Instead of a full repeat year on-books there is the possibility to apply through their Tutor to take the following year as an Off-Books student taking Assessment in this module, if they are eligible to do so.*
- Example of a capped reassessment:
    - *Student C in their Semester 2 SF module obtains a mark of 50% in their labs, 80% in their assignments but 20% in their examination with weightings of 30%, 10% and 60% respectively. Their module mark is thus (50*0.3) + (80*0.1) + (20*0.6) = 15+8+12 = 35%. This is a Fail and they are reassessed in the failed component, and not eligible for compensation or a Qualified Pass as they had a mark <30% in their examination.*
    - *In their reassessed exam, having engaged at length with the material they perform well in their examination and would obtain a mark of 80%. This exam mark component is capped at 60% while the other component marks remain as they were.*
    - *The final mark is thus calculated as: (50*0.3) + (80*0.1) + (**60***0.6) = 15+8+36 = 59% for the module.*

Important Note on Examinations, Assessments and Reassessments in Fresher years

- There is a minimum mark requirement of 30% separately in the Examination component and the Laboratory component, in order for a Pass or Qualified Pass

mark in the module to be granted. Other components making up fewer marks are not included in this requirement. A mark of less than 30% in either of these Examination or Laboratory components leads to a Qualified Fail and requires reassessment examination or a repeat of the year.

- There is a maximum mark or cap of 60% on any reassessed component in this module if reassessment is required. The final module mark is calculated based on the reassessed component mark and any already achieved marks for components that did not need to be reassessed, according to the published weightings of these components.
- Re-assessment capping does not apply to deferred 1st attempts at assessment.
- These apply to all students in this module.
- For more details please see the section in the School of Physics Undergraduate Handbook on "Progression regulations applying to Physics modules and accredited Physics programmes" available in full at: https://www.tcd.ie/physics/study/current/undergraduate/handbook/ or see a summary at: https://www.tcd.ie/physics/study/current/undergraduate/progression

Reading List:

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

Online Assignments:

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

Online Resources:

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

Module Website:

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

Contact Details

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PYU11P20: Physics 2

Semester 2, 10 credits

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

Structure and contact hours:

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

Lecture Topics:

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

Learning Outcomes:

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

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

Syllabus:

Electricity and Magnetism I: 20 lectures

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

• Materials Physics: - 16 lectures

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

Gravitation and Astrophysics: 14 lectures

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

Method of Assessment and Weighting:

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

Progression regulations applying to Physics modules and accredited Physics programmes.

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

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

A) Minimum mark requirement and Qualified Fails in Fresher years

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

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

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

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

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

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

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

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

stream of the student, registration or visiting student status, or year of first admission. The Sophister PYU modules are not available to any other non-accredited Sophister degree programmes.

- Re-assessment capping does not apply to deferred 1st attempts at assessment.

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

Examples in Junior Fresh or Senior Fresh of Qualified Fails:

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

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

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

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

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

Reading List

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

Online assignments:

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

Online Resources:

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

Module website:

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

PYU11P10 and PYU11P20: Physics 1 and Physics 2 Laboratory Practical

Summary of Laboratory Practical

Across Physics 1 and Physics 2 modules students complete 2 computational physics experiments (using Python) and 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 2025/2026 but with virtual partners, possibly augmented by at-home experimental measurements. Some assessments may then also take place in a virtual interview, instead of at-bench interviews.

Laboratory Practical:

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

Online Resources:

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

Assessment of the laboratory

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

Contact Details:

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

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/

Progression regulations applying to Chemistry modules.

An overview of the progression regulations within the Chemical Sciences programme is detailed here.

(a) Minimum mark requirement and Qualified Fails in Fresher years

The progression and regulations rules for chemistry modules are different to modules associated to different Schools. In modules with a practical component (CHU11101, CHU11102, CHU22201 and CHU22202) a minimum mark requirement applies to the examination and practical separately as outlined below:

(i) These regulations apply to the Fresher JF and SF 10 credit modules that are core to Chemical Sciences (TR061), and which are available as Open modules to JF and SF Physical Sciences (TR063) and Geosciences (TR062) students.
These modules are JF: CHU11101 and CHU11102; and in SF: CHU22201 and CHU22202. *(This does not include CHU22M03 and CHU22204).*

(ii) In these Fresher modules there is a **minimum mark requirement of 35%** in the Examination component and **40%** 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 35% in the Examination or less than 40% in the 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 35% occurs or recurs in the examination or less than 40% in the laboratory component following the reassessment period, the student cannot progress and must repeat the year. This necessarily applies to students who had deferred their first attempt at examinations to the reassessment period.

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

(b) Capping of reassessed components in the reassessment session in Fresher years

In all chemistry related reassessments (with or without a practical component), a cap (maximum mark) of 40% will apply as outlined below:

(i) All the reassessed components for Junior Fresh and Senior Fresh Chemistry modules delivered as part of the Chemical Sciences (and available to students in the Physical Sciences and Geosciences courses as Open modules). These modules are JF: CHU11101 and CHU11102; and in SF: CHU22201, CHU22202, CHU22M03 and CHU22204.

(ii) Re-assessment capping does not apply to deferred 1st attempts at assessment.

The full text of these derogations from the College Progression and Award rules can be found at: https://www.tcd.ie/academic-affairs/academic-regulations/-undergraduate-progression-and-awards

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

Non-satisfactory attendance in Science

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

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

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

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

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-Bcn6aBJpJezeqwuYapUMkpaU1E5SDY5TDZaTUhYU01PMlhBV0kxSyQlQCN0PWcu **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.

Email Protocols for Students

Every student has a TCD email address. You are expected to check this regularly and to read and act promptly upon all messages sent to you.
You should check your College email daily during teaching term as it will be used to communicate important information. If away from Trinity on Erasmus or on an exchange you should still check your TCD mail periodically.

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

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

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

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

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

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

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

Guidelines on Marking for Junior and Senior Fresh Courses

Class	Mark Range	Criteria
I	90-100	**EXCEPTIONAL ANSWER:** This answer will show original thought and a sophisticated insight into the subject, and mastery of the available information on the subject. It should make compelling arguments for any case it is putting forward and show a rounded view of all sides of the argument. In exam questions important examples will be supported by attribution to relevant authors and while not necessary giving the exact date, should show an awareness of the approximate period. In essays the references will be comprehensive and accurate
	80-89	**OUTSTANDING ANSWER**: This answer will show frequent originality of thought and make new connections between pieces of evidence beyond those presented in lectures. There will be evidence of awareness of the background behind the subject area discussed, with evidence of deep understanding of more than one view on any debatable points. It will be written clearly in a style which is easy to follow. In exams authors of important example s may be provided. In essays all important examples will be referenced accurately.
	70-79	**INSIGHTFUL ANSWER:** Showing a grasp of the full relevance of all course material discussed and will include one or two examples from wider reading to extend the arguments presented. It should show some original connections of concepts. There will be only minor errors in examples given. All arguments will be entirely logical and well written. Referencing in exams will be sporadic but referencing should be presented and accurate in essays.
II-1	65-69	**VERY COMPREHENSIVE ANSWER:** Good understanding of the concepts supported by broad knowledge of the subject. Notable for synthesis of information rather than originality. Evidence of relevant reading outside lecture notes and coursework. Mostly accurate and logical with appropriate examples. Occasional lapse in detail.
	60-64	**LESS COMPRESHENSIVE ANSWER**: Mostly confined to good recall of coursework. Some synthesis of information or ideas. Accurate and logical within a limited scope. Some lapses in detail tolerated. Evidence of reading the assigned course literature.
Class	**Mark Range**	Criteria

II-2	**50-59**	**SOUND BUT INCOMPLETE ANSWER**: Based on coursework alone but suffers from significant omission, error or misunderstanding. Usually lacks synthesis of information or ideas. Mainly logical and accurate within its limited scope with lapses in detail
	50-54	**INCOMPLETE ANSWER:** Suffers from significant omissions, errors and misunderstandings, but still understanding of main concepts and showing sound knowledge. Several lapses in detail.
III	**45-49**	**WEAK ANSWER:** Limited understanding and knowledge of subject. Serious omissions, errors and misunderstandings, so the answer is no more than adequate
	40-44	**VERY WEAK ANSWER:** A poor answer, lacking substance but giving some relevant information. Information given may not be in context or well explained, but will contain passages and words, which indicate a marginally adequate understanding.
Fail	**35-39**	**MARGINAL FAIL:** Inadequate answer with no substance or understanding but with a vague knowledge relevant to the question.
	30-34	**CLEAR FAILURE:** Some attempt made to write something relevant to the question. Errors serious but not absurd. Could also be a sound answer to the misinterpretation of a question.
	0-29	**UTTER FAILURE**: With little hint of knowledge. Errors serious and absurd. Could also be a trivial response to the misinterpretation of a question.

Academic Integrity

Trinity College Dublin, the University of Dublin, is committed to upholding academic integrity, and recognises that it underpins all aspects of university life, including all activities relating to research, learning, assessment, and scholarship.

Trinity therefore considers academic misconduct to be serious and academically fraudulent and an offence against academic integrity that is subject to the Trinity procedures in cases of suspected misconduct.

The Academic Integrity Policy (https://www.tcd.ie/media/tcd/about/policies/pdfs/academic/Academic-Integrity-Policy.pdf) should be read in conjunction with (and is subject to) the University Calendar, Part II on Academic Integrity (This policy replaces the Plagiarism Policy).

Other sources of information are available:
https://www.tcd.ie/calendar/undergraduate-studies/
https://libguides.tcd.ie/academic-integrity
https://www.tcd.ie/teaching-learning/academic-affairs/academic-integrity/
https://www.tcd.ie/teaching-learning/academic-affairs/academic-integrity/mandatory-academic-integrity-training/

Guidance on the Use of AI and Generative AI in College

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

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

Artificial Intelligence (AI)

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

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

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

AI and GenAI in Trinity
As Ireland's leading university and as a world leader in AI research, Trinity recognises that AI and GenAI offer new opportunities for teaching, learning, assessment and research. We also

recognise that these technologies present challenges and risks, including to academic integrity, ethics, privacy, impartiality, intellectual property and sustainability.

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

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

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

Trinity Tutorial Service

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

Opening Hours

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

Appointments

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

What is a Tutor?

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

When should I go to see my Tutor?

Whenever you are worried or concerned about any aspect of College life or your personal life, in particular if it is affecting your academic work. Everything you say to your Tutor is in strict confidence. Unless you give him/her permission to do so, s/he will not give any information to anybody else, whether inside College or outside (to your parents/family for example). Your Tutor can only help you if s/he knows you are facing difficulties, so if you are worried about anything go and see your Tutor before things get out of hand.

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

Disability Services

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

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

Student Counselling

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

If you wish to make an appointment with the Student Counselling Service, please consider one of the options below. If you have any other queries you can call into reception on the 3rd floor of 7-9 South Leinster Street or contact us on:
Phone: (01) 8961407
Email: student-counselling@tcd.ie

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

Helpful College Websites:

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

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

For information on Registration, Fees, Grants, ID Cards etc. visit the Academic Registry (AR) in the Watts Building or 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 of study.

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

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

Dates to Note:

Fresh Orientation: 15th September to 19th September 2025

Semester one term dates: 22nd September to 01th December 2025

Study Week Semester 1: 27th October to 31st of October 2025

Semester one examinations: 15th December to 22nd of December 2025

Semester two term dates: 19th January to 10th of April 2026

Study week semester 2: 02nd March to 06th of March 2026

Semester two examinations: 21st April to 1st of May 2026

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

*** Orientation week for new entrants**

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

October bank holiday – Monday 27th October 2025

College will be closed from the 24th of December 2025 to the 1st of January 2026

February bank holiday – Monday 2nd February 2026

St Patrick's Day - Tuesday 17th March 2026

TR061 Chemical Sciences

Contact details:

Course Director TR061: Chemical Sciences	E-mail: southerj@tcd.ie
Professor Mike Southern	Phone:01 896 3411
Coordinator Fresh Teaching	E-mail: jfchem@tcd.ie
Dr Noelle Scully	Ph: 01 896 1972
Administrative Officer	E-mail: farrea25@tcd.ie
Ms. Anne Marie Farrell	Ph: 01 896 1726

Science Course Office

Associate Dean of Undergraduate Science Education	E-mail: jacksoan@tcd.ie
Professor Andrew Jackson	Ph: 018961366
Science Course Office Manager	E-mail: ennisa@tcd.ie
Ms. Ann Marie Brady	Ph: 01 896 2829
Administrative Officer/ Senior Fresh Coordinator	E-mail: sherwinh@tcd.ie
Ms. Helen Sherwin Murray	Ph: 01 896 2799
Executive Officer/ Front House	E-mail: dossanta@tcd.ie
Ms. Andressa dos Santos Melo	Ph: 01 896 1970
Administrative Officer/ Junior Fresh Coordinator	E-mail: segurar@tcd.ie
Ms. Romarey Segura	Ph: 01 896 2022

Appendix 1

Item	Reference/Source
General College Regulations	Calendar, Part II, General Regulations and Information,Section II, Item 12
Emergency Procedures	In the event of an emergency, **dial Security Services on extension 1999** Security Services provide a 24-hourservice to the college community, 365 days a year. They are the liaison to the Fire, Garda and Ambulance services and all staff and students are advised to alwaystelephone extension 1999 (+353 1 896 1999) in case of an emergency. Should you require any emergency or rescue services on campus, you must contact Security Services. This includes chemical spills,personal injury or first aid assistance. It is recommended that all studentssave at least one emergency contact in their phone under ICE (In Case of Emergency).
Health and Safety	Faculty of Science, Technology, Engineering and Mathematics website - https://www.tcd.ie/stem/undergraduate/health-safety.php School Handbooks will have School/Discipline information on Health and Safety.
Data Protection	https://www.tcd.ie/dataprotection/ https://www.tcd.ie/dataprotection/assets/docs/dataprotectionhandbook/DP_Handbook_15042021.pdf
Academic Integrity	https://www.tcd.ie/teaching-learning/academic-integrity/
Research Ethics	https://www.tcd.ie/research/support/ethics-integrity.php
Blackboard	Blackboard
Explanation of Weightings	https://www.tcd.ie/teaching-learning/ug-egulations/Academic_credit_system.php
Assessment and Progression Regulations	https://www.tcd.ie/media/tcd/about/policies/pdfs/academic/assess-acad-prog-nov2021.pdf https://www.tcd.ie/teaching-learning/academic-affairs/ug-prog-award-regs/ Calendar, Part II, General Regulations and Information,Section

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

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

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