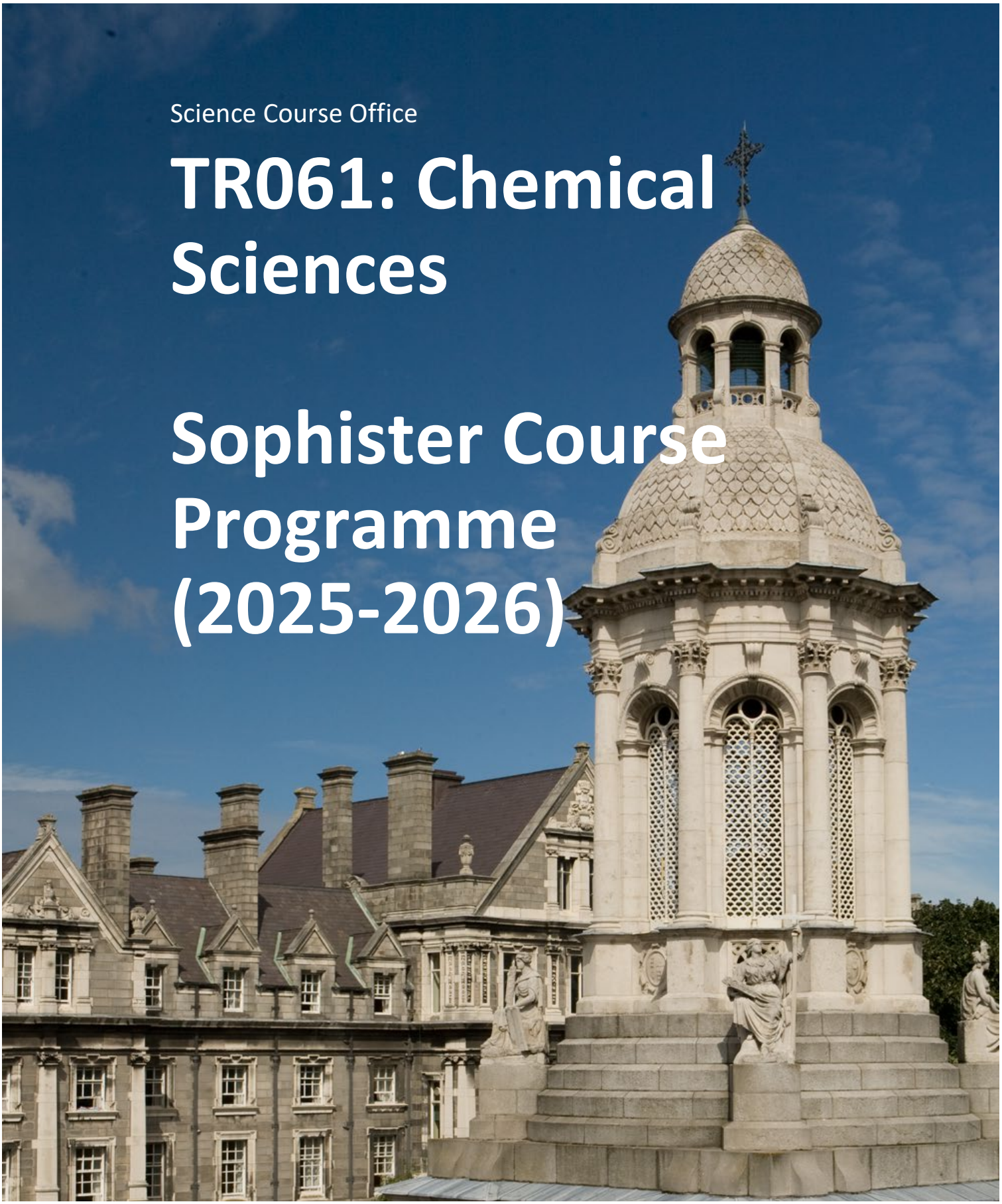
Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin



Science Course Office

TR061: Chemical Sciences

Sophister Course Programme (2025-2026)

This programme booklet applies to all student taking TR061: Chemical Sciences. It is a guide to what is expected of you on the programme and the supports available to you. Please retain for future reference.

The information provided is correct at the time of publication. Any necessary revisions will be notified to students via email and the TR061: Chemical Sciences webpage: https://www.tcd.ie/science/undergraduate/tr061-chemical-sciences/junior-sophister/

In the event of any conflict or inconsistency between the General Regulations published in the University Calendar and the information provided in this course programme, the general college regulations will prevail: https://www.tcd.ie/calendar/undergraduate-studies/general-regulations-and-information.pdf

Produced by:	The Science Course Office Trinity College, Dublin 2
Email:	Science@tcd.ie
Webpage:	https://www.tcd.ie/science/undergraduate/

Welcome

Dear Students

Congratulations – you are nearing the end of the Fresh years of your degree and are ready to make the important decision about which chemical sciences Moderatorship you wish to pursue. The Fresh course structure has given you an excellent grounding in your core subject to prepare you for the advanced material you will cover in your Sophister years. You have also had opportunities to take open modules in other science subjects that have given breadth and context to your science education.

Development of educational breadth continues in the Sophister years via the opportunity to take further open modules and also Trinity Electives. Trinity Electives are stand-alone, College-wide modules that enable you to broaden your knowledge outside of your chosen subject. There is a wide range of choice available to you that encompasses languages and cultures, key societal challenges and Trinity's ground-breaking research activities.

A list of the modules can be found at this link (https://www.tcd.ie/trinity-electives/apply/).

Having the opportunity to develop these broader skills, particularly in communication and presentation, will allow you to derive the greatest benefits from your particular choice of Moderatorship subject and will give you important insights into other subjects and modes of scholarship outside of the sciences.

I wish you the very best in your Sophister years and look forward to seeing your future successes and achievements.

Prof Fraser Mitchell
Associate Dean of Undergraduate Science Education

Foreword from the Course Director/Director of Teaching and Learning, Undergraduate

Together with the Associate Dean of Undergraduate Science Education I, as Course Director of the Chemical Sciences, wish all the soon-to-be Sophister students well in the final two years of their degree. This handbook reflects the structure of each of the Sophister years in all five of the Moderatorships available within the Chemical Sciences course. These five are of course the **Chemistry** Moderatorship, the **Medicinal Chemistry** Moderatorship, the **Chemistry with Molecular Modelling Moderatorship, Chemistry with Biosciences** Moderatorship and the **Nanoscience** Moderatorship. The structures, core modules, practical elements, progression, capstone research projects, and the choices available (Junior Sophister Open, Junior Sophister Trinity Elective) are listed in this handbook.

As the Chemical Sciences Moderatorships have been rapidly evolving in light of the Trinity Education Project, all the information presented here is as accurate as possible at the time of compilation of this document. However, module codes, the module content, the choice or breadth, or timing of available Core, Mandatory, Open or Optional modules and details of examinations are subject to change between this academic year and the beginning of the next when the rising Senior Sophister students will embark on the final year of the Moderatorships within Chemical Sciences. We are very happy for you to be with us on this exciting journey where these five Moderatorships are now presented in a way not possible before now with Core components and Open modules in Junior Sophister and a new range of Optional modules in the Senior Sophister year.

Specifically, there are opportunities within each Moderatorship to tailor your degree through your parallel choice of Trinity Electives; by subsequent choices within the Junior Sophister year of Junior Sophister Open modules; your preference for your Senior Sophister capstone project, and your selection from among the Senior Sophister Optional modules. Whatever your pathway and whatever the Moderatorship ultimately chosen each of our chemistry degrees offers you a wide range of transferable skills that will be of value in research, industry, or business.

Best wishes to all,

Prof Valeria Nicolosi
Director of Teaching and Learning, Undergraduate
School of Chemistry

Introduction

Sophister courses in **Chemical Sciences** are organised so that students follow a continuous programme of work over two years leading to a Moderatorship in a particular subject. Each module (comprising lectures, tutorials, seminars and/or practicals) has a specified credit value, which is an approximate measure of the workload associated with the module and is in turn reflected in its proportional weighting towards module assessment. One credit is normally considered to represent a minimum of 20 hours of work on the part of a student. Students take modules to the value of 60 credits in each of the Sophister years.

The Chemical Sciences (TR061) Sophister Course Booklet is intended as a detailed and comprehensive guide to all Moderatorships within the Chemical Sciences.

While every effort will be made to give due notice of major changes, the School of Chemistry and the Science Course Office reserve the right to suspend, alter or initiate courses, timetables, examinations and regulations at any time.

Description of ECTS system

The European Credit Transfer and Accumulation System (ECTS) is an academic credit system based on the estimated student workload required to achieve the objectives of a module or programme of study. It is designed to enable academic recognition for periods of study, to facilitate student mobility and credit accumulation and transfer. The ECTS is the recommended credit system for higher education in Ireland and across the European Higher Education Area.

The ECTS weighting for a module is a **measure of the student input or workload** required for that module, based on factors such as the number of contact hours, the number and length of written or verbally presented assessment exercises, class preparation and private study time, laboratory classes, examinations, clinical attendance, professional training placements, and so on as appropriate. There is no intrinsic relationship between the credit value of a module and its level of difficulty.

The European **norm for full-time study over one academic year is 60 credits**. Within Undergraduate courses 1 credit represents 20-25 hours estimated student input, so a 10-credit module will be designed to require 200-250 hours of student input including class contact time, assessments and examinations. Within Postgraduate courses 1 credit represents 25 hours estimated student input, so a 10-credit module will be designed to require 200-250 hours of student input including class contact time, assessments and examinations.

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

Course Advisors

Chemical Sciences Course Director	Prof. Valeria Nicolosi	NICOLOV@tcd.ie
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Junior Sophister Coordinator	Prof. Peter Dunne	P.W.Dunne@tcd.ie

Moderatorship Courses and Quotas

To be qualified for a Moderatorship, students must have successfully completed both Fresh years and must have taken the stated prerequisite modules for any Moderatorship for which they wish to be considered. All students in Chemical Sciences who have completed both Fresh years are eligible to proceed into the **Chemistry** or the **Chemistry with Molecular Modelling** Moderatorships. The three Moderatorships with a prerequisite are **Nanoscience** (where a student must have taken all of the Physics modules in the two Fresh years), **Chemistry with Biosciences** (where a student must have taken all of the Biology modules in the two Fresh years) and **Medicinal Chemistry** (where a student must have taken all of the Biology modules in the two Fresh years).

While every effort will be made to give due notice of major changes in the quotas, the Chemical Sciences Course Director reserves the right to alter prerequisites and quotas, if necessary. In the case of the Nanoscience Moderatorship this will be in conjunction and in consultation with the Physical Sciences Course Director and the Nanoscience Moderatorship Course Director.

Moderatorship	**Quotas**
Chemistry	30
Medicinal Chemistry	30
Chemistry with Molecular Modelling	8
Nanoscience	10 + 6*
Chemistry with Biosciences	10

***Note regarding Nanoscience quota.** Nanoscience is a shared course between the Schools of Physics and Chemistry and is accessible through both Physical Sciences (TR063) and Chemical Sciences (TR061) for students with the appropriate 120 credits of Fresh modules in Physics, Chemistry and Mathematics. Thus the 10 highest ranked students from both Physical Sciences and Chemical Sciences are allocated places in the Nanoscience Moderatorship. Six additional places are available to the highest ranked qualified students from either Physical or Chemical Sciences who have not already been allocated a place in the Moderatorship.

Allocation of Places

The Science Course office coordinates and processes the applications for Junior Sophister places in the TR061: Chemical Sciences course. The procedures documented below show students that those places are allocated in a fair, transparent, and efficient manner.

The number of places available in each moderatorship is limited by quota. **Allocation is based on the overall mark obtained in the Senior Fresh year** and the order of choice expressed by the student.

The Science Course Office allocates Junior Sophister places. Students cannot be allocated a place by circumventing the Science Course Office and going directly to disciplines. All enquiries regarding the allocation of places, made to disciplines, will be redirected to the Science Course Office via the sophistersco@tcd.ie email address.

Places will be allocated as follows until quotas are reached:

1. All students passing their Senior Fresh year will be placed in **rank order** based on their **overall Senior Fresh year mark**.
2. Students who fail and are required to sit reassessment must reapply for the remaining unfilled places until quotas are reached. Second round forms will be made available via the relevant course page on the Science website: https://www.tcd.ie/Science/ following publication of the first round.
3. Students who are given permission by the Senior Lecturer to defer assessments and or examinations until the reassessment session may defer a place in their **first** preference only. Following publication of the results, students who pass at the reassessment session will be allocated a place based on the same criteria used in the first-round allocation of places. If the student in this category does not qualify for the deferred place, the Science Course Office will allocate that student a place in one of the subjects available in the second round and the deferred place will be offered to the next qualified student from the first-round allocation.
4. In the event a student fails at the reassessment session, be that a deferred exam or reassessment, and are eligible to repeat the SF year, they can do so in **one** of the following ways:
    - Repeating the year in full on books, such students will be treated in the same way as all other SF students in that year.
    - Students may request permission from the Senior Lecturer, via their tutor, to repeat the year off books taking assessment (**OBA**). Sitting an exam OBA is a repeat examination, therefore, such students will be allocated a place in one of the remaining Moderatorships available at the **reassessment session** the following year. Students may not repeat more than 20 credits OBA.
5. Students who have passed in the **first round** who then opt to go 'off books' for the year (**OBN**) rather than take up the place offered, will be allocated a place in the first round along with rising JS students in the following year. Places will **not** be reserved for such students.
6. Students who pass in the second round and opt to go "off books" prior to places being allocated, will be allocated a place at the **reassessment session** in the following year.
7. Results will be available on your personal portal at my.tcd.ie by the stated publication date.
8. Publication of first round JS places will be available through the my.tcd.ie portal once the academic year rollover happens in July.
9. Students are informed by email when the places are published, and the procedures followed are clearly outlined in the email.

Special note: Students who have passed their Senior Fresh year may not repeat the SF year to improve their performance.

Timeline of events

Date	Trinity Term 2025
18.03.25	Information session for Chemistry with Biosciences and Medicinal Chemistry – 11.00 – 12.00, Fitzgerald Lecture Theatre, Physics Building
21.03.25	Information session for Chemistry, Chemistry with Molecular Modelling and Nanoscience – 12.00 – 13.00, LTEE2
18.04.25	Closing date for submission of Moderatorship Preference Forms https://forms.office.com/e/bzkAixDCwS
22.04.25 – 02.05.25	Semester two examinations
29.05.25	Publication of Science Examination results – mytcd.ie portal
07.07.25	Publication of Junior Sophister places via my.tcd.ie

Trinity Electives

https://www.tcd.ie/trinity-electives/

The Trinity Electives are a unique feature of your Trinity Education. They are standalone, College-wide 5 credit modules. They cover a broad range of topics in the arts, humanities, sciences, health and social science, and technology. They are designed to allow students to study topics outside of their core discipline and thus provide breadth in their education. Chemical Sciences students take a minimum of one and a maximum of two (one per semester) Trinity Electives in the Junior Sophister year. Depending on your moderatorship, you will choose a combination of Trinity Electives and Open Modules as described in this handbook.

Choosing your Trinity Elective

The choice of Trinity Elective is student driven. Almost all Trinity Electives are open to all students. However, students of some moderatorships may be precluded from taking certain Trinity Electives (e.g. the module 'From Planets to the Cosmos' is not available to TR063 Physical Sciences students, as this topic is part of their core discipline,). The list of exemptions is outlined in the Trinity Electives webpage: https://www.tcd.ie/trinity-electives/

Selection of Trinity Electives will be made through online enrolment which will open in July 2025, after publication of examination results and allocation of moderatorship places. You will select your Trinity Electives on a first come first served basis through online module enrolment in your TCD portal. The Trinity Electives website provides full details of each of the Trinity Electives. A list of the Trinity Electives can be found at https://www.tcd.ie/trinity-electives/

You need to think carefully about your choice of Trinity Elective as taking an elective in semester 2 restricts the open module options available to choose from.

Junior Sophister Examination Information

Modules are assessed by continuous assessment and/or by examination. The Junior Sophister year comprises modules to a total of 60 credits. The distribution scheme of marks between papers and practical work at the Sophister examinations will be published by individual schools or departments/disciplines.

Calculation of Moderatorship results

The final moderatorship results are calculated as a weighted average of the overall result for the Junior and Senior Sophister examination results.

Junior Sophister 30%, Senior Sophister 70%:

Chemistry, Chemistry with Biosciences, Chemistry with Molecular Modelling, Medicinal Chemistry and Nanoscience.

Reassessment - Regulation 8: Undergraduate Progression and awards regulations

- Same progression regulations, including compensation, for assessments relating to semesters 1 & 2 and to reassessment.
- Automatic right to reassessment for a student who has achieved a fail grade in any of their modules and is not eligible for compensation.
- Students (in all years) should only be required to re-sit examinations or re-submit coursework for failed modules or components thereof.
- Students are not permitted to present for reassessment in any module for which they have achieved a pass grade, in order to improve their academic performance.
- Rescheduled exams within the session will no longer be permitted.
- Different reassessment modalities permitted.
- A cap (maximum mark) of 60% will apply to i) all reassessed components for *all* modules in the Sophister years (except Trinity Electives) within the five programmes of Chemistry, Medicinal Chemistry, Chemistry with Molecular Modelling, Nanoscience and Chemistry with Biosciences irrespective of the owning School. (See Appendix 1 for module details).
- The above-mentioned capping applies to reassessed components of the School of Chemistry (CHU code) modules irrespective of the registration or visiting student status, or year of first admission.
- Re-assessment capping does not apply to deferred 1st attempts during the re-assessment session. Further information is available in the relevant programme handbooks.

Repetition of a year: Regulation 7: Undergraduate Progression and awards regulations

- Students are not permitted to repeat any academic year more than once and may not repeat more than two academic years within a programme.
- Repetition of a year is in full, i.e., all modules and all assessment components.
- A student's academic record on their transcript will show clearly the time lost through repetition of a year.
- There will be an option to repeat a year on an 'off-books' basis.

Full **Progression and Awards** regulations can be found via the following:
https://www.tcd.ie/teaching-learning/academic-affairs/ug-prog-award-regs/index.php

TR061: Moderatorships and Approved Module Choice Diagram

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

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

The curriculum in the five Moderatorships is tailored to offer a general chemistry degree (C), a chemistry degree with an emphasis on molecular modelling (CMM), a degree focusing on the synthesis and applications of drugs for medicinal purposes (MC), a degree with emphasis on the chemistry and physics of advanced materials and nanomaterials (N), and a degree focusing on the interface between chemistry and biology (CB). 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 credits dedicated to each discipline depend on module pattern choice and are outlined below:

Pattern SF.1 fulfils requisites for Moderatorships in C, CMM, MC, CB	**Patterns SF.2-3** fulfils requisites for Moderatorships in C, CMM, MC, CB	**Patterns SF.4** fulfils requisites for Moderatorships in C, CMM, MC, CB	**Pattern SF.5** fulfils requisites for Moderatorships in C, CMM, N
30 ECTS Chemistry	25 ECTS Chemistry	20 ECTS Chemistry	20 ECTS Chemistry
5 ECTS Maths	10 ECTS Maths	15 ECTS Maths	15 ECTS Maths
5 ECTS History, Philosophy and Ethics of Science	5 ECTS History, Philosophy and Ethics of Science	5 ECTS History, Philosophy and Ethics of Science	5 ECTS History, Philosophy and Ethics of Science
20 ECTS Biology	20 ECTS Biology	20 ECTS Biology	20 ECTS Physics

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

Chemistry	**Chemistry with Molecular Modelling**	**Medicinal Chemistry**	**Chemistry with Biosciences**	**Nanoscience**
All 5 patterns	All 5 patterns	Patterns SF.1-4	Patterns SF.1-4	Pattern SF.5 only

Moderatorship Preference Form

Students are required to complete the choice of subject form. You will rank your subject preferences from 1-4 i.e., Chemistry 1, Chemistry with Biosciences 2, etc.

The form is available online https://forms.office.com/e/bzkAixDCwS. The closing date is **18 April 2025**

Open Module Choice Forms

Students take modules totalling 60 credits in the Junior Sophister year. There are 40 credits of core modules and 20 credits of open modules spread equally over two semesters in the academic year. The module structure for each individual moderatorship is listed in the following pages.

In addition, students can choose one or two (one per semester) 5 credit Trinity Elective modules as shown in the module structure table for each moderatorship subject.

Students can choose their open modules with the help of the Moderatorship Course Adviser following the allocation of moderatorship places. **Online Open Module Choice forms will be available from your moderatorship discipline.**

Students should note that due to timetable constraints Open Modules may be delivered *via* a blended learning approach involving face to face and online teaching for some open modules.

Taking two Trinity Electives, (one in each semester) restricts the number of open modules you can take. Please refer carefully to the tables in this handbook.

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

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

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

Unauthorized late submissions of coursework will result in a 10% reduction in marks for the first 24-hour delay and a 5% reduction per day thereafter.

Full regulations on non-submission of coursework can be found via the following:
https://www.tcd.ie/calendar/undergraduate-studies/general-regulations-and-information.pdf
Please refer to your school/department/discipline handbook for specific moderatorship regulations.

Academic Integrity Policy

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 are disruptive in both positive and negative ways. Before using them in your studies it is important that you familiarise yourself with College policies on its use. Unless otherwise instructed for particular modules or assessments, **the default expectation would be that you do not submit AI generated content as an attempt at an assessment**.

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

Artificial Intelligence (AI)

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

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

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

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

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

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

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

Junior Sophister Chemistry/MedChem/CMM Course Structure Diagram

The Junior Sophister course structure is diagrammatically illustrated below:

Junior Sophister TR061 - Chem/CMM/MedChem			
40 ECTS Core			
Semester 1		**Semester 2**	
CHU33209 (Org Lab; 5 ECTS)	CHU33409 (ACM Workshop; 5 ECTS)	CHU33109 (Inorg Lab; 5 ECTS)	CHU33309 (PhysChem Lab; 5 ECTS)
CHU33405 (5 ECTS) Interdisciplinary Methods	CHU33207 (5 ECTS) Organic Chemistry	CHU33107 (5 ECTS) Inorganic Chemistry	
CHU33303 (5 ECTS) Physical Chemistry			
20 ECTS Open Modules/Elective			
Elective 1 (5 ECTS) **Mandatory**		Elective 2 (5 ECTS) **Optional**	
		Open Modules (5 ECTS each)	
		Organic*/Inorganic/Physical**/MedChem*** * Organic option is **compulsory** for MedChem **Physical option is **compulsory** for CMM ***Medchem is **compulsory** for MedChem and an **option** for ChemBio. Not available for Chem or CMM.	

Table 1: JS modules by moderatorship: Core ✓; Option ○; Unavailable ×.

Year	Semester	ECTS	Module code	Module Title	Chem	CMM	MedChem	ChemBio	Nano
JS	1	5	CHU33207	Synthetic Organic Chemistry	✓	✓	✓	✓	×
		5	CHU33209	Practical in Organic Chemistry	✓	✓	✓	✓	×
		5	CHU33303	Quantum Mechanical Concepts in Physical Chemistry	✓	✓	✓	✓	×
		5	CHU33405	Analytical and Computational Methods	✓	✓	✓	✓	✓
		5	CHU33409	Analytical and Computational Methods Labs/Workshops	✓	✓	✓	✓	✓
		5	PYU33P01	Quantum Mechanics	×	×	×	×	✓
		5	PYU33P02	Electromagnetic Interactions	×	×	×	×	✓
		5	Electives‡		✓	✓	✓	✓	×
	1-2	10	PYU33NP3	Practical in Physics	×	×	×	×	✓
	2	5	CHU33107	Organometallic and Coordination Chemistry	✓	✓	✓	✓	✓
		5	CHU33109	Practical in Inorganic Chemistry	✓	✓	✓	×	×
		5	CHU33309	Practical in Physical Chemistry	✓	✓	✓	×	×
		5	CHU33509	Practical in Physical/Inorganic Chemistry for ChemBio	×	×	×	✓	×
		5	CHU33603	Practical in Physical/Inorganic Chemistry for Nano	×	×	×	×	✓
		5	CHU33105†	Chemistry of Polymers and Macromolecules	○	○	○	○	○
		5	CHU33205	Advanced Organic Transformations	○	○	✓	○	×
		5	CHU33307	Solid State Materials and Modelling	○	✓	○	○	✓
		5	CHU33442	Drug Design and Development	×	×	✓	○	×
		5	BYU22206	Microbes, Immune Systems and their Interaction	×	×	×	✓	×
		5	BYU22207	Genomes, Disease and Diversity	×	×	×	✓	×
		5	BYU33102	From Organisms to Ecosystems	×	×	×	✓	×
		5	PYU33P03	Condensed Matter	×	×	×	×	✓
		5	PYU33P04†	Semiconductor Physics	×	×	×	×	○
		5	Electives‡		○	○	○	×	✓

Details for each individual moderatorship and brief descriptor for each module are outlined in the next section.

Senior Sophister Chemistry/MedChem/CMM Course Structure Diagram

The Senior Sophister course structure is diagrammatically illustrated below:

<table>
<tr><th colspan="3">Senior Sophister TR061 – Chem/CMM/MedChem</th></tr>
<tr><th colspan="3">40 ECTS Core</th></tr>
<tr><th>Semester 1</th><th colspan="2">Semester 2</th></tr>
<tr><td rowspan="2">CHU44120/CHU44420/CHU44720 Capstone Project
(20 ECTS)</td><td>CHU44304 (5 ECTS)
Physical Chemistry</td><td>CHU44204 (5 ECTS)
Organic Chemistry</td></tr>
<tr><td>CHU44004 (5 ECTS)
Inorganic Chemistry</td><td></td></tr>
<tr><td>CHU44123 Problems Module (5 ECTS)</td><td colspan="2"></td></tr>
<tr><td colspan="3">20 ECTS Options</td></tr>
<tr><td rowspan="2"></td><td colspan="2">Option Modules (10 ECTS each)</td></tr>
<tr><td colspan="2">OChem*/IChem/PChem/CMM**
MedChem Option (only available for MedChem Moderatorship; compulsory)
*OChem option is compulsory for MedChem
**CMM option is compulsory for CMM</td></tr>
</table>

Table 2: SS modules by moderatorship: Core ✓; Option ○; Unavailable ×.

Year	Semester	ECTS	Module code	Module Title	Chem	CMM	MedChem	ChemBio	Nano
SS	1	20	CHU44120	Capstone Project	✓	✓	✓	✓	×
	1-2	5	CHU44123	Problems Module	✓	✓	✓	✓	×
	1-2	20	PYU44NP2	Capstone Project (Nanoscience)	×	×	×	×	✓
	1-2	10	PYU44N02	Nanoscience, Polymers and Soft Matter	×	×	×	×	✓
	1	5	PYU44NP5	Problems Module (Nanoscience)	×	×	×	×	✓
	2	5	CHU44004	Inorganic Chemistry	✓	✓	✓	✓	✓
		5	CHU44204	Organic Chemistry	✓	✓	✓	✓	×
		5	CHU44304	Physical Chemistry	✓	✓	✓	✓	✓
		10	CHU44005	Advanced Inorganic Chemistry	○	○	×	×	○
		10	CHU44205	Advanced Organic Chemistry	○	○	✓	×	×
		10	CHU44405	Advanced Medicinal Chemistry	×	×	✓	×	×
		10	CHU44167	Advanced Physical Chemistry	○	○	×	×	○
		10	CHU44705	Advanced Computational Chemistry	○	✓	×	×	○
		5	BIU3350	Molecular Basis of Disease	×	×	×	✓	×
		5	BIU33250	Introduction to Immuno/Metabolism	×	×	×	✓	×
		10	BIU33010	Nucleic Acids	×	×	×	✓	×
		5	PYU44P13	Magnetism and Superconductivity	×	×	×	×	○
		5	PYU44P05	Electromagnetic Interactions II	×	×	×	×	○
		5	PYU44P06	Modern Optics	×	×	×	×	○
		5	PYU44P17	Energy Science	×	×	×	×	○

Details for each individual moderatorship and brief descriptor for each module are outlined in the next section.

Chemistry

The Chemistry moderatorship affords access to a wide range of careers in industry, academia, and the professions. By choice of practical project and of lecture options in the final year, a student may specialise in Organic, Physical or Inorganic Chemistry.

Junior Sophisters:
The JS year consists of lectures, tutorials and practicals delivered in modules, as listed below. Within the Junior Sophister year in Chemistry there are 40 credits of Core modules, with the remaining 20 credits comprising either Open or Elective modules. **All students are required to take a Trinity Elective in the first semester.**

Mandatory: In order to reinforce and extend a student's laboratory skills in Chemistry, rising Junior Sophister students **are required** to attend workshops on Safety, held at the beginning of Semester 1. Attendance at all workshops **is compulsory**.

Assessment and Examination Procedures:
The lecture material in Chemistry will be examined in module examination papers taken during the relevant examination period. Practical work is assessed in-course. Further information relating to the assessed components and composition of written papers will be given at the beginning of Semester 1. The JS Chemistry mark will contribute 30% of the final degree mark.

Senior Sophisters:
In SS year, students attend a series of core modules (in Physical, Organic and Inorganic Chemistry), four specialised open modules of their choice and associated tutorials. In addition, students are required to attend research seminars and undertake a Capstone project in a research lab.

Assessment and Examination Procedures:
Core and open modules detailing advanced topics in Organic, Inorganic and Physical Chemistry will be examined during the Annual Examination periods. The Research Project is assessed in-course. The SS Chemistry mark will contribute 70% to the final degree mark. All modules are weighted according to their respective credit rating. Further information relating to the assessed components, composition of written papers and credit weightings will be given at the beginning of Semester 1.

Junior Sophister Chemistry Core Modules 40 credits

(CHU33405) Analytical and Computational Methods (S1) 5 credits
This module introduces the student to instrumental methods in analytical chemistry and to modern computational tools to understand chemical structure and interpret spectroscopic results.

(CHU33207) Synthetic Organic Chemistry (S1) 5 credits
This module is aimed at achieving an understanding of fundamental reaction mechanisms of transition-metal-catalysed reactions, introducing the student to the different reactivities of organoheteroatom compounds and rearrangement reactions and at providing the student with a grounding in the advanced selective oxidative and reductive transformations necessary to apply retrosynthetic analysis effectively.

(CHU33303) Quantum Mechanical Concepts in Physical Chemistry (S1) 5 credits
This module seeks to introduce the student to the fundamental aspects of quantum mechanics and the use of Schrödinger's equations to describe particle systems in chemistry.

(CHU33107) Organometallics and Coordination Chemistry (S2) 5 credits
The aim of this module is to develop an understanding of the main methods of synthetic organometallic chemistry, fundamental structure-reactivity relationships, and concepts of bonding and structure, functional group chemistry, thermodynamics and kinetics.

CHU33409 Analytical and Computational Methods Labs/Workshops (S1) 5 credits
CHU33209 Practical in Organic Chemistry (S1) 5 credits
CHU33109 Practical in Inorganic Chemistry (S2) 5 credits
CHU33309 Practical in Physical Chemistry (S2) 5 credits
These practical laboratory modules introduce the student to instrumental methods in analytical chemistry and to modern computational tools to understand chemical structure and interpret spectroscopic results. Practical modules in Organic, Inorganic and Physical Chemistry will enable the student to gain practical experience of techniques and methods in traditional and modern chemistry.

Junior Sophister Open Modules and Trinity Electives 20 credits

(CHU33205) Advanced Organic Transformations (S2) 5 credits
This module is aimed at achieving an advanced understanding of the reactivity of heterocyclic compounds, introducing the student to applications of molecular orbital theory for organic reactivity, and integrating physical chemistry principles into their understanding of organic chemistry reactions.

(CHU33105) Chemistry of Polymers and Macromolecules (S2) 5 credits
This module introduces the student to polymer and macromolecular chemistry. Polymer based materials are an important component of many devices and products.

(CHU33307) Solid State Materials and Modelling (S2) 5 credits
This module introduces the student to the fundamental aspects of solid-state materials and their modelling. It will focus on the electronic structure and defects and how these can be used to influence the properties of materials and hence create functional materials.

Trinity Elective (S1) :(compulsory) and (S2):(optional) 5 credits
Details on Trinity Electives can be found at https://www.tcd.ie/trinity-electives/electives/

Senior Sophister Chemistry Core Modules 40 credits

(CHU44120) Capstone Project (S1) 20 credits
The Capstone project will be carried out during S1 under the supervision of a member of staff in the School of Chemistry or in an overseas institute and must be completed and assessed by the end of the semester. Details of start dates, thesis submission dates and assessments will be provided at the beginning of S1 and can be found in the SS handbook.

(CHU44123) Problems Module (S1) 5 credits
A set of long problems based on material covered in Organic, Inorganic and Physical Chemistry modules will be completed and submitted by all students during S1. In addition to the continuous assessment element of this module, students will be asked about a problem in an oral examination. In semester 2 students will be assessed via a written in-class closed-book assessment consisting of short problems based on material covered in the Core chemistry modules from Years 1-3 only. Tutorials on problem-solving will be provided before study week of semester 2.

(CHU44204) Organic Chemistry (S2) 5 credits
This module is aimed at achieving an understanding of advanced aspects of organic chemistry including retrosynthesis, reactive intermediates including synthetic radical and carbene chemistry, and planning of total synthesis.

(CHU44004) Inorganic Chemistry (S2) 5 credits
The student will be introduced to advanced synthetic methods in materials chemistry. The module focuses on an understanding of the fundamental concepts of structure-property relationships to design materials for specific applications (*e.g.,* alloys, ceramics, glasses, inorganic polymers and various composite materials). The second part of the module will introduce the students to the molecular chemistry of the f-block elements (lanthanides and actinides).

(CHU44304) Physical Chemistry (S2) 5 credits
The student will be introduced to statistical thermodynamics and its applications in chemistry, integrating this topic with the kinetics, classical thermodynamics and quantum chemistry covered in previous years. The second part of the module will cover elements of soft matter and macromolecular and colloid chemistry.

Senior Sophister Chemistry Option Modules 20 credits

(CHU44205) Advanced Organic Chemistry (S2) 10 credits
This module is aimed at achieving an understanding of advanced aspects of organic chemistry including photochemistry, supramolecular chemistry, chemical biology, asymmetric synthesis and advanced topics in organic synthesis.

(CHU44005) Advanced Inorganic Chemistry (S2) 10 credits
This module covers aspects of advanced coordination, organometallic and bioinorganic chemistry. It focuses on structure-property relationships and outlines characterisation techniques for bioinorganic systems. In addition, the module will cover aspects of crystal growth, emphasising the interplay between composition, structure, morphology and properties.

(CHU44167) Advanced Physical Chemistry (S2) 10 credits
The student will be introduced to advanced topics in physical chemistry that integrate and build on the core concepts of kinetics, thermodynamics and quantum chemistry covered in core physical chemistry modules. Topics will include: (a) electrochemistry and its applications to energy devices for sustainability, (b) photochemistry and spectroscopy, and (c) surface and interfacial chemistry, including catalysis for the environment.

(CHU44705) Advanced Computational Chemistry (S2) 10 credits
This module will cover the main computational quantum chemistry methods and computational techniques, including optimisation and molecular dynamics, used in the modelling of structure, chemical reactivity and electronic properties of molecular systems and solid crystals. The performance and suitability of these methods for different applications will also be analysed and discussed. In addition, lectures will be complemented with computational practicals so that students can see a direct application of these methods.

Chemistry Moderatorship Learning Outcomes

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

- Articulate in written and oral form a foundation level of knowledge and understanding of the biological, physical and quantitative sciences underpinning Chemistry.
- Apply key concepts in the major chemical sub-disciplines of Physical, Inorganic and Organic Chemistry.
- Design, perform, and analyse the results obtained from experiments in physical, inorganic and organic chemistry, using modern chemical experimental methodology and instrumentation.
- Demonstrate skills in problem-solving, critical thinking and analytical reasoning, and be able to effectively communicate the results of their work to chemists and non-chemists, both verbally and in writing.
- Use modern library searching and retrieval methods to obtain information pertinent to the identification and solution of chemical problems and the exploration of new research areas.
- Work effectively and safely in a laboratory environment operating within the proper procedures and regulations for safe handling and use of chemicals.
- Update their knowledge and to undertake further study with a high degree of autonomy and ethical responsibility.

Chemistry with Molecular Modelling

Course Advisor: Prof. Graeme Watson
A degree in Chemistry with Molecular Modelling allows access to a wide range of careers in industry, academia and the professions.

Junior Sophisters:
The JS year consists of lectures, tutorials and practicals with Molecular Modelling, delivered in modules, as listed below. Within the Junior Sophister year in Chemistry there are 40 credits of Core modules, with the remaining 20 credits being either Open or Trinity Elective modules. **All students are required to take a Trinity Elective in the first semester.**

Mandatory: In order to reinforce and extend a student's laboratory skills in Chemistry, rising Junior Sophister students **are required** to attend workshops on Safety, held at the beginning of Semester 1. Attendance at all workshops **is compulsory**.

Assessment and Examination Procedures:
The lecture material in Chemistry will be examined in module examination papers taken during the relevant examination period. Practical work is assessed in-course. Further information relating to the assessed components and composition of written papers will be given in at the beginning of Semester 1. The JS Chemistry mark will contribute 30% of the final degree mark.

Senior Sophisters:
In SS year, students attend a series of core modules (in Physical, Organic and Inorganic Chemistry), two specialised modules and associated tutorials. In addition, students are required to attend research seminars and undertake a Capstone project in a research lab.

Assessment and Examination Procedures:
Core and open modules detailing advanced topics in Organic, Inorganic and Physical Chemistry will be examined during the Annual Examination periods. The Research Project is assessed in-course. The SS Chemistry mark will contribute 70% to the final degree mark. All modules are weighted according to their respective credit rating. Further information relating to the assessed components, composition of written papers and credit weightings will be given at the beginning of Semester 1.

Junior Sophister Chemistry with Molecular Modelling Core Modules 40 credits

(CHU33405) Analytical and Computational Methods (S1) 5 credits
This module introduces the student to instrumental methods in analytical chemistry and to modern computational tools to understand chemical structure and interpret spectroscopic results.

(CHU33207) Synthetic Organic Chemistry (S1) 5 credits
This module is aimed at achieving an understanding of fundamental reaction mechanisms of transition metal-catalysed reactions, introducing the student to the different reactivities of organoheteroatom compounds and at providing the student with a grounding in the advanced selective oxidative and reductive transformations necessary to apply retrosynthetic analysis effectively.

(CHU33303) Quantum Mechanical Concepts in Physical Chemistry (S1) 5 credits
This module introduces the student to the fundamental aspects of quantum mechanics and the use of Schrödinger's equations to describe particle systems in chemistry.

(CHU33107) Organometallics and Coordination Chemistry (S2) 5 credits
The aim of this module is to develop an understanding of the main methods of synthetic organometallic chemistry, fundamental structure-reactivity relationships, and concepts of bonding and structure, functional group chemistry, thermodynamics and kinetics.

CHU33409 Analytical and Computational Methods Labs/Workshops (S1) 5 credits
CHU33209 Practical in Organic Chemistry (S1) 5 credits
CHU33109 Practical in Inorganic Chemistry (S2) 5 credits
CHU33309 Practical in Physical Chemistry (S2) 5 credits

These practical laboratory modules introduce the student to instrumental methods in analytical chemistry and to modern computational tools to understand chemical structure and interpret spectroscopic results. Practical modules in Organic, Inorganic and Physical Chemistry will enable the student to gain practical experience of techniques and methods in traditional and modern chemistry.

Junior Sophister Chemistry with Molecular Modelling Open Modules and Trinity Electives **20 credits**

(CHU33205) Advanced Organic Transformations (S2) 5 credits
This module is aimed at achieving an advanced understanding of the reactivity of heterocyclic compounds, introducing the student to applications of molecular orbital theory for organic reactivity, and integrating physical chemistry principles into their understanding of organic chemistry reactions.

(CHU33105) Chemistry of Polymers and Macromolecules (S2) 5 credits
This module introduces the student to polymer and macromolecular chemistry. Polymer based materials provide important components of many devices and products.

(CHU33307) Solid State Materials and Modelling (S2): Mandatory 5 credits
This model introduces the student to the fundamental aspects of solid-state materials and their modelling. It will focus on the electronic structure and defects and how these can be used to influence the properties of materials and hence create functional materials.

Trinity Elective (S1) :(compulsory) and (S2): (optional) 5 credits
Details on Trinity Electives are found at: https://www.tcd.ie/trinity_electives/electives.

Senior Sophister Chemistry with Molecular Modelling Core Modules 40 credits

(CHU44720) Capstone Project (S1) 20 credits
The Capstone project will be carried out during S1 under the supervision of a member of staff in the School of Chemistry or in an overseas institute and must be completed and assessed by the end of the semester. Details of start dates, thesis submission dates and assessments will be provided at the beginning of semester 1.

(CHU44123) Problems Module (S1) 5 credits
A set of long problems based on material covered in Organic, Inorganic and Physical Chemistry modules will be completed and submitted by all students during S1. In addition to the continuous assessment element of this module, students will be asked about a problem in an oral examination. In semester 2 students will be assessed via a written in-class closed-book assessment consisting of short problems based on material covered in the Core chemistry modules from Years 1-3 only. Tutorials on problem-solving will be provided before study week of semester 2.

(CHU44204) Organic Chemistry (S2) 5 credits
This module is aimed at achieving an understanding of advanced aspects of organic chemistry including retrosynthesis, reactive intermediates including synthetic radical and carbene chemistry, and planning of total synthesis.

(CHU44004) Inorganic Chemistry (S2) 5 credits
The student will be introduced to advanced synthetic methods in materials chemistry. The module focuses on an understanding of the fundamental concepts of structure-property

relationships to design materials for specific applications (e.g., alloys, ceramics, glasses, inorganic polymers and various composite materials). The second part of the module will introduce the students to the molecular chemistry of the f-block elements (lanthanides and actinides).

(CHU44304) Physical Chemistry (S2) **5 credits**

The student will be introduced to statistical thermodynamics and its applications in chemistry, integrating this topic with the kinetics, classical thermodynamics and quantum chemistry covered in previous years. The second part of the module will cover elements of soft matter and macromolecular and colloid chemistry.

Senior Sophister Chemistry with Molecular Modelling Optional Modules 20 credits

(CHU44205) Advanced Organic Chemistry (S2) **10 credits**

This module is aimed at achieving an understanding of advanced aspects of organic chemistry including photochemistry, supramolecular chemistry, chemical biology, asymmetric synthesis, and advanced topics in organic synthesis.

(CHU44005) Advanced Inorganic Chemistry (S2) **10 credits**

This module covers aspects of advanced coordination, organometallic and bioinorganic chemistry. It focuses on structure-property relationships and outlines characterisation techniques for bioinorganic systems. In addition, the module will cover aspects of crystal growth, emphasising the interplay between composition, structure, morphology and properties.

(CHU44167) Advanced Physical Chemistry (S2) **10 credits**

The student will be introduced to advanced topics in physical chemistry that integrate and build on the core concepts of kinetics, thermodynamics and quantum chemistry covered in core physical chemistry modules. Topics will include: (a) electrochemistry and its applications to energy devices for sustainability, (b) photochemistry and spectroscopy, and (c) surface and interfacial chemistry, including catalysis for the environment.

(CHU44705) Advanced Computational Chemistry (S2) * **10 credits**

This module will cover the main computational quantum chemistry methods and computational techniques, including optimisation and molecular dynamics, used in the modelling of structure, chemical reactivity and electronic properties of molecular systems and solid crystals. The performance and suitability of these methods for different applications will also be analysed and discussed. In addition, lectures will be complemented with computational practicals so that students can see a direct application of these methods.

*Compulsory for CMM moderatorship

Chemistry with Molecular Modelling Moderatorship Learning Outcomes

On the successful completion of this programme, a student should be able to

- Articulate in written and oral form a foundation level of knowledge and understanding of the biological, physical and quantitative sciences underpinning Chemistry.

- Apply key concepts in the major chemical sub-disciplines of Physical, Inorganic and Organic Chemistry.

- Design, perform, and analyse the results obtained from experiments in physical, inorganic, and organic chemistry, using modern chemical experimental methodology and instrumentation.

- Demonstrate skills in problem solving, critical thinking and analytical reasoning, and be able to effectively communicate the results of their work to chemists and non-chemists both verbally and in writing.

- Use modern library searching and retrieval methods to obtain information pertinent to the identification and solution of chemical problems and the exploration of new research areas.

- Work effectively and safely in a laboratory environment operating within the proper procedures and regulations for safe handling and use of chemicals.

- Demonstrate knowledge of molecular modelling techniques and their implementation.

- Design and perform appropriate theoretical calculations to solve chemical problems and analyse the results.

- Update their knowledge and to undertake further study with a high degree of autonomy.

Medicinal Chemistry

Course Advisor: Prof. Mike Southern.
Medicinal Chemistry is the area of chemistry that bridges chemistry, pharmacy and medicine and specialises in drug discovery, development and translational chemistry. The specialisation really begins in the Sophister years, building upon the fundamental principles covered in the Fresh years. From a chemistry perspective the focus is on both Organic and Medicinal Chemistry. Graduates will receive a degree in Medicinal Chemistry, which affords access to a wide range of careers in industry, academia and the professions.

Junior Sophisters:
The JS year consists of lectures, tutorials and practicals delivered in modules, as listed below. Within the Junior Sophister year in Chemistry there are 40 credits of Core modules, with the remaining 20 credits comprising either Open or Trinity Elective modules. **All students are required to take a Trinity Elective in the first semester.**

Mandatory: In order to reinforce and extend a student's laboratory skills in Chemistry, rising Junior Sophister students **are required** to attend workshops on Safety, held at the beginning of Semester 1. Attendance at all workshops **is compulsory**.

Assessment and Examination Procedures:
The lecture material in Chemistry will be examined in module examination papers taken during the relevant examination period. Practical work is assessed in-course. Further information relating to the assessed components and composition of written papers will be given in at the beginning of Semester 1. The JS Chemistry mark will contribute 30% of the final degree mark.

Senior Sophisters:
In SS year, students attend a series of core modules (in Physical, Organic and Inorganic Chemistry), two specialised option topics and associated tutorials. In addition, students are required to attend research seminars and undertake a Capstone project in a research lab.

Assessment and Examination Procedures:
Core and open modules detailing advanced topics in Organic, Inorganic and Physical Chemistry will be examined during the Annual Examination periods. The Research Project is assessed in-course. The SS Chemistry mark will contribute 70% to the final degree mark. All modules are weighted according to their respective credit rating. Further information relating to the assessed components, composition of written papers and credit weightings will be given at the beginning of Semester 1.

Junior Sophister Medicinal Chemistry Core Modules 40 credits

(CHU33405) Analytical and Computational Methods (S1) 5 credits
This module introduces the student to instrumental methods in analytical chemistry and to modern computational tools to understand chemical structure and interpret spectroscopic results.

(CHU33207) Synthetic Organic Chemistry (S1) 5 credits
This module is aimed at achieving an understanding of fundamental reaction mechanisms of transition metal-catalysed reactions, introducing the student to the different reactivities of organoheteroatom compounds, rearrangement reactions, and at providing the student with a grounding in the advanced selective oxidative and reductive transformations necessary to apply retrosynthetic analysis effectively.

(CHU33303) Quantum Mechanical Concepts in Physical Chemistry (S1) 5 credits
This module seeks to introduce the student to the fundamental aspects of quantum mechanics and the use of Schrödinger's equations to describe particle systems in chemistry.

(CHU33107) Organometallics and Coordination Chemistry (S2) 5 credits
The aim of this module is to develop an understanding of main methods of synthetic organometallic chemistry, fundamental structure-reactivity relationships, and concepts of bonding and structure, functional group chemistry, thermodynamics and kinetics.

CHU33409 Analytical and Computational Methods Labs/Workshops (S1) 5 credits
CHU33209 Practical in Organic Chemistry (S1) 5 credits
CHU33109 Practical in Inorganic Chemistry (S2) 5 credits
CHU33309 Practical in Physical Chemistry (S2) 5 credits
These practical laboratory modules introduce the student to instrumental methods in analytical chemistry and to modern computational tools to understand chemical structure and interpret spectroscopic results. Practical modules in Organic, Inorganic and Physical Chemistry will enable the student to gain practical experience of techniques and methods in traditional and modern chemistry.

Junior Sophister Medicinal Chemistry Open Modules and Trinity Electives 20 credits

(CHU33205) Advanced Organic Transformations (S2) :(compulsory) 5 credits
This module is aimed at achieving an advanced understanding of the reactivity of heterocyclic compounds, key rearrangement reactions of reactive intermediates, introducing the student to applications of molecular orbital theory for organic reactivity, and integrating physical chemistry principles into their understanding of organic chemistry reactions.

(CHU33105) Chemistry of Polymers and Macromolecules (S2) 5 credits
This module introduces the student to polymer and macromolecular chemistry. Polymer based materials provide important components of many devices and products.

(CHU33307) Solid State Materials and Modelling (S2) 5 credits
This model introduces the student to the fundamental aspects of solid-state materials and their modelling. It will focus on the electronic structure and defects and how these can be used to influence the properties of materials and hence create functional materials.

(CHU33442) Drug Design and Development (S2): (compulsory) 5 credits
This module is aimed at introducing the student to drug design and development with special focus on antivirals, antibiotics and therapeutics in cancer treatment. The student will also be introduced to the principles of QSAR in drug design.

Trinity Elective (S1) :(compulsory) and (S2): (optional) 5 credits
Details on Trinity Electives can be found at https://www.tcd.ie/trinity-electives/electives/

Senior Sophister Medicinal Chemistry Core Modules 40 credits

(CHU44420) Capstone Project (S1) 20 credits
The Capstone project will be carried out during S1 under the supervision of a member of staff in the School of Chemistry or in an overseas institute and must be completed and assessed by the end of the semester. Details of start dates, thesis submission dates and assessments will be provided at the beginning of S1.

(CHU44123) Problems Module (S1) 5 credits
A set of long problems based on material covered in Organic, Inorganic and Physical Chemistry modules will be completed and submitted by all students during S1. In addition to the continuous assessment element of this module, students will be asked about a problem in an oral examination. In semester 2 students will be assessed via a written in-class closed-book assessment consisting of short problems based on material covered in the Core chemistry modules from Years 1-3 only. Tutorials on problem-solving will be provided before study week of semester 2.

(CHU44204) Organic Chemistry (S2) 5 credits
This module is aimed at achieving an understanding of advanced aspects of organic

chemistry including retrosynthesis, reactive intermediates including synthetic radical and carbene chemistry, and planning of total synthesis.

(CHU44004) Inorganic Chemistry (S2) 5 credits
The student will be introduced to advanced synthetic methods in materials chemistry. The module focuses on an understanding of the fundamental concepts of structure-property relationships to design materials for specific applications (*e.g.,* alloys, ceramics, glasses, inorganic polymers and various composite materials). The second part of the module will introduce the students to the molecular chemistry of the f-block elements (lanthanides and actinides).

(CHU44304) Physical Chemistry (S2) 5 credits
The student will be introduced to statistical thermodynamics and its applications in chemistry, integrating this topic with the kinetics, classical thermodynamics and quantum chemistry covered in previous years. The second part of the module will cover elements of soft matter and macromolecular and colloid chemistry.

Senior Sophister Medicinal Chemistry Option Modules* 20 credits

(CHU44205) Advanced Organic Chemistry (S2) 10 credits
This module is aimed at achieving an understanding of advanced aspects of organic chemistry including photochemistry, supramolecular chemistry, chemical biology, asymmetric synthesis and advanced topics in organic synthesis.

(CHU44405) Advanced Medicinal Chemistry (S2) 10 credits
This module is aimed at achieving an understanding of advanced aspects of medicinal chemistry including concepts and targets in medicinal chemistry, the cardiovascular system, the central nervous system, computational medicinal chemistry, drug discovery and combinatorial chemistry.

*Both Advanced Organic Chemistry and Advanced Medicinal Chemistry modules are mandatory for the Med Chem moderatorship.

Medicinal Chemistry Moderatorship Learning Outcomes

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

- Articulate in written and oral form a foundation level of knowledge and understanding of the biological, chemical and quantitative sciences underpinning Medicinal Chemistry.
- Apply key concepts in the major chemical sub-disciplines of Physical, Inorganic and Organic Chemistry with particular reference to Medicinal Chemistry.
- Design, perform, and analyse the results obtained from experiments in physical, inorganic and organic chemistry, using modern chemical experimental methodology and instrumentation.
- Demonstrate skills in problem solving, critical thinking and analytical reasoning, and be able to effectively communicate the results of their work to chemists, biologists, clinicians and others both verbally and in writing.

- Use modern library searching and retrieval methods to obtain information pertinent to the identification and solution of chemical problems and the exploration of new research areas.
- Work effectively and safely in a laboratory environment operating within the proper procedures and regulations for safe handling and use of chemicals and instrumentation.
- Demonstrate knowledge of medicinal chemistry techniques and their implementation.
- Combine accrued knowledge to design and prepare drug candidates.
- Update their knowledge and to undertake further study with a high degree of autonomy and in an ethically considered manner.

Chemistry with Biosciences

Course Advisor: Prof. Joanna McGouran

Chemistry with Biosciences is the area of chemistry that bridges chemistry, biochemistry, immunology and biosciences while maintaining a solid foundation in chemistry. The specialisation really begins in the Sophister years, expanding upon the biological topics covered in the Fresh years alongside core and optional chemistry modules. Graduates will receive a degree in Chemistry with Biosciences, which affords access to a wide range of careers in industry, academia and the professions. This degree is particularly suited to interdisciplinary careers such as medical writing, patent law and biologics research and manufacturing.

Junior Sophisters:
The JS year consists of lectures, tutorials and practical laboratory sessions delivered in modules, as listed below. Within the Junior Sophister year in Chemistry there are 35 credits of Core Chemistry modules, 15 credits of Core Biosciences with the remaining 10 credits comprising either Open or Trinity Elective modules. **All students are required to take a Trinity Elective in the first semester.**

Mandatory: In order to reinforce and extend a student's laboratory skills in Chemistry, rising Junior Sophister students **are required** to attend workshops on Safety, held at the beginning of Semester 1. Attendance at all workshops **is compulsory**.

Assessment and Examination Procedures:
The lecture material in Chemistry will be examined in module examination papers taken during the relevant examination period. Practical work is assessed in-course. Further information relating to the assessed components and composition of written papers will be given in at the beginning of Semester 1. The JS Chemistry mark will contribute 30% of the final degree mark.

Senior Sophisters:
In SS year, students attend a series of core modules (in Physical, Organic and Inorganic Chemistry), two specialised option topics and associated tutorials. In addition, students are required to attend research seminars and undertake a Capstone project in a research lab.

Assessment and Examination Procedures:
Core and open modules detailing advanced topics in Organic, Inorganic and Physical Chemistry will be examined during the Annual Examination periods. The Research Project is assessed in-course. The SS Chemistry mark will contribute 70% to the final degree mark. All modules are weighted according to their respective credit rating. Further information relating to the assessed components, composition of written papers and credit weightings will be given at the beginning of Semester 1.

Junior Sophister Chemistry with Biosciences Course Structure

Junior Sophister TR061 – Chemistry with Biosciences			
40 ECTS Core			
Semester 1		**Semester 2**	
CHU33209 (Org Lab; 5 ECTS)	CHU33409 (ACM Workshop; 5 ECTS)	CHU33509 (Inorg& Phys Labs; 5 ECTS)	
CHU33405 (5 ECTS) Interdisciplinary Methods	CHU33207 (5 ECTS) Organic Chemistry I	CHU33107 (5 ECTS) Inorganic Chemistry	
CHU33303 (5 ECTS) Physical Chemistry		BYU22207 (5 ECTS) Genomes, Disease and Diversity Lect & Lab*	BYU22206 (5 ECTS) Microbes, Immune Systems & their Interaction Lect & Lab*
5 ECTS Electives/Options		**10 ECTS Open**	
Elective 1		Chem option from JS (subject to timetabling)	BYU33102 (5 ECTS) From Organisms To Ecosystems no labs, lectures only*

* Provisional modules, subject to timetabling
Details for each individual moderatorship and brief descriptor for each module are outlined below.

Junior Sophister Chemistry with Biosciences Core Modules (provisional) 45 credits

(CHU33405) Analytical and Computational Methods (S1) 5 credits
This module introduces the student to instrumental methods in analytical chemistry and to modern computational tools to understand chemical structure and interpret spectroscopic results.

(CHU33207) Synthetic Organic Chemistry (S1) 5 credits
This module is aimed at achieving an understanding of fundamental reaction mechanisms of transition metal-catalysed reactions, introducing the student to the different reactivities of organoheteroatom compounds, rearrangement reactions, and at providing the student with a grounding in the advanced selective oxidative and reductive transformations necessary to apply retrosynthetic analysis effectively.

(CHU33303) Quantum Mechanical Concepts in Physical Chemistry (S1) 5 credits
This module seeks to introduce the student to the fundamental aspects of quantum mechanics and the use of Schrödinger's equations to describe particle systems in chemistry.

(CHU33107) Organometallics and Coordination Chemistry (S2) 5 credits
The aim of this module is to develop an understanding of the main methods of synthetic organometallic chemistry, fundamental structure-reactivity relationships, and concepts of bonding and structure, functional group chemistry, thermodynamics and kinetics.

CHU33409 Analytical and Computational Methods Labs/Workshops (S1) 5 credits
CHU33209 Practical in Organic Chemistry (S1) 5 credits
CHU33509 Combined Practical in Inorganic and Physical Chemistry (S2) 5 credits

These practical laboratory modules introduce the student to instrumental methods in analytical chemistry and to modern computational tools to understand chemical structure and interpret spectroscopic results. Practical modules in Organic, Inorganic and Physical Chemistry will enable the student to gain practical experience of techniques and methods in traditional and modern chemistry.

(BYU22207) Genomes, Disease and Diversity (S2) 5 credits
Through lectures (content delivery, explanation) practicals (practice in techniques and problem solving) we will provide students with a broad overview of the genomics and the impact of new approaches across the biosciences. We will introduce the basics of new technologies and show the application of these to study of a) inherited traits, including Mendelian and complex human diseases; b) the non-inherited somatic genome with particular focus on cancer; c) human kinship and origins; d) the microbiome; and e) the genomics of ecology.

(BYU22206) Microbes, Immune Systems and their Interaction (S2) 5 credits
The microbial world existed successfully for 1.5 billion years before multicellular organisms began to appear. During that time, microbes evolved multiple defence mechanisms against potential competitors. Even when multicellular organisms evolved, microbes continued to exist successfully, often in harmony. Many of these mechanisms are conserved in multicellular organisms and used in defence against potential pathogens. In this module, students will learn about immune systems that have evolved over billions of years and about the complex interactions between microbes and their hosts which can lead to significant disease but which are also required for health. Students will learn about the molecular and cellular biology of key pathogens (viral, prokaryotic and eukaryotic) which currently threaten human populations; they will learn about immune systems and the diverse mechanisms used by immune molecules and cells to detect and respond to these microbes.

Junior Sophister Chemistry with Biosciences Open Modules and Trinity Electives

(Provisional) 15 credits

(BYU33102) From Organisms to Ecosystems (S2): (Compulsory) 5 credits
This module introduces students to the biology of individuals, species, populations and ecosystems, and explores how humans interact with other living organisms. It covers the developmental biology of organisms, their physiology, brain function and the evolutionary and ecological responses of organisms to their environment. Topics incorporate the diversity of life and its biological development, interactions between organisms and their environment, the biological context of climate change, human impacts on the environment, future food sustainability, urban ecology, ecosystem services and the value and conservation of biodiversity. There is one practical that will be held in Trinity's Botanic Garden and an MCQ test as well as the exam component.

(CHU33205) Advanced Organic Transformations (S2): 5 credits
This module is aimed at achieving an advanced understanding of the reactivity of heterocyclic compounds, key rearrangement reactions of reactive intermediates, introducing the student to applications of molecular orbital theory for organic reactivity, and integrating physical chemistry principles into their understanding of organic chemistry reactions.

(CHU33105) Chemistry of Polymers and Macromolecules (S2) 5 credits
This module introduces the student to polymer and macromolecular chemistry. Polymer based materials provide important components of many devices and products.

Trinity Elective (S1) :(compulsory) 5 credits
Details on Trinity Electives can be found at https://www.tcd.ie/trinity-electives/electives/

Senior Sophister Chemistry with Biosciences Course Structure

<table>
<tr><th colspan="4">Senior Sophister TR061 – Chemistry with Biosciences</th></tr>
<tr><th colspan="4">60 ECTS Total</th></tr>
<tr><th colspan="2">Semester 1</th><th colspan="2">Semester 2</th></tr>
<tr><td colspan="2">Capstone Project</td><td>CHU44004 Inorganic Chemistry</td><td>CHU44204 Organic Chemistry</td></tr>
<tr><td>CHU44123 Synoptic Problem solving</td><td>BIU3350 Molecular Basis of Disease* (Planned online)</td><td>CHU44304 Physical Chemistry</td><td>BIU33250 Introduction to Immuno/metabolism (Planned online)*</td></tr>
<tr><td colspan="2"></td><td colspan="2">BIU44610-Nucleic acids 10 credits. Lect & Labs*</td></tr>
</table>

*Provisional modules-subject to timetabling

Details for each individual moderatorship and brief descriptor for each module are outlined in the next section.

Senior Sophister Chemistry with Biosciences Core Modules

(CHU44520) Capstone Project (S1) 20 credits
The Capstone project will be carried out during S1 under the supervision of a member of staff in the School of Chemistry/Biochemistry or in an overseas institute and must be completed and assessed by the end of the semester. Details of start dates, thesis submission dates and assessments will be provided at the beginning of S1.

(CHU44123) Problems Module (S1) 5 credits
A set of long problems based on material covered in Organic, Inorganic and Physical Chemistry modules will be completed and submitted by all students during S1. In addition to the continuous assessment element of this module, students will be asked about a problem in an oral examination. In semester 2 students will be assessed via a written in-class closed-book assessment consisting of short problems based on material covered in the Core chemistry modules from Years 1-3 only. Tutorials on problem-solving will be provided before study week of semester 2.

(BIU33350) Molecular Basis of Disease (S1) 5 credits
This module is to provide students with the grounding in cell signalling and disease biology and how modern therapeutics are designed, developed and deployed for the treatment of human diseases. The topics covered will include cell signalling, drug design and delivery, and will focus on the molecular basis of cancer, pro-inflammatory disease, and metabolic disorders. Students will be assessed via an MCQ test and end-of-term exam.

(CHU44204) Organic Chemistry (S2) 5 credits
This module is aimed at achieving an understanding of advanced aspects of organic chemistry including retrosynthesis, reactive intermediates including synthetic radical and carbene chemistry, and planning of total synthesis.

(CHU44004) Inorganic Chemistry (S2) 5 credits
The student will be introduced to advanced synthetic methods in materials chemistry. The module focuses on an understanding of the fundamental concepts of structure-property relationships to design materials for specific applications (*e.g.,* alloys, ceramics, glasses, inorganic polymers and various composite materials). The second part of the module will introduce the students to the molecular chemistry of the f-block elements (lanthanides and actinides).

(CHU44304) Physical Chemistry (S2) 5 credits
The student will be introduced to statistical thermodynamics and its applications in chemistry, integrating this topic with the kinetics, classical thermodynamics and quantum chemistry covered in previous years. The second part of the module will cover elements of soft matter and macromolecular and colloid chemistry.

Senior Sophister Chemistry with Biosciences Open Modules* 15 credits

(BIU33250) Introduction to Immunology & Immunometabolism (S2) 5 credits
This module introduces the basic components and function of the immune system – the molecules, cells, tissues and organs that make up the immune system. It will illustrate the immune responses to infection. Additionally, it will introduce students to the importance of central energy and intermediary metabolic pathways or bioenergetics before considering how they are dysregulated in diseases like cancer and also how we can harness this knowledge for new immunotherapies.

(BIU44610) Nucleic Acids (S2) 10 credits
This module covers the structure and function of nucleic acids in a eukaryotic context. The basis of gene transcriptional regulation and mRNA translation are described at a mechanistic and structural level in addition to the processes involved in DNA replication and repair. The lectures of this module are accompanied by a set of practical sessions (15 contact hours) that include:
(i) analysis of plasmid DNA, digestion and cloning, transformation and selection of bacteria; laboratory and tutorial sessions.
(ii) PCR and qRT-PCR, analysis and tutorial.

*For Chemistry with Biosciences these modules are compulsory

Chemistry with Biosciences Moderatorship Learning Outcomes

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

- Articulate in written and oral form a foundation level of knowledge and understanding of the biological, chemical and quantitative sciences.
- Apply key concepts in the major chemical sub-disciplines of Physical, Inorganic and Organic Chemistry.
- Apply key concepts in biosciences sub-disciplines including genetics, biochemistry and immunology.
- Design, perform, and analyse the results obtained from, experiments in physical, inorganic and organic chemistry, using modern chemical experimental methodology and instrumentation.
- Design, perform, and analyse the results obtained from, biochemical and molecular biology protocols, using modern biochemical experimental techniques and instrumentation.
- Demonstrate skills in problem solving, critical thinking and analytical reasoning, and be able to effectively communicate the results of their work to chemists, biologists and others both verbally and in writing.
- Use modern library searching and retrieval methods to obtain information pertinent to the identification and solution of chemical and biological problems and the exploration of new research areas.
- Work effectively and safely in a laboratory environment operating within the proper procedures and regulations for safe handling and use of chemicals, biological samples and instrumentation.
- Update their knowledge and to undertake further study with a high degree of autonomy and in an ethically considered manner.

Nanoscience

Junior Sophister **Course Advisor: Professor Matthias Moebius (mobiusm@tcd.ie)**

Nanoscience is a moderatorship taught jointly by the Schools of Physics and Chemistry. Building on the foundation courses taken in the Fresh years, students follow in-depth courses across the spectrum of modern physics, physical chemistry, materials science and nanoscience while reflecting the strength of Trinity's research expertise in these areas.

Junior Sophister:

The Junior Sophister year consists of lectures, tutorials and practicals delivered in modules, as listed below. Within the Junior Sophister year in Nanoscience there are 40 credits of Core modules, with the remaining 20 credits comprising either Open or Elective modules. Some Open modules are in fact mandatory and this requirement in the Junior Sophister year is to satisfy the progression of students in this specialised degree. **All Nanoscience students are required to take a Trinity Elective in the second semester of their Junior Sophister year.** Students receive training in communication skills within the practical modules.

Safety:
To reinforce and extend laboratory skills rising Junior Sophister students are required to attend workshops on Chemical and Laboratory Safety to be held at the beginning of semester one. Attendance at all workshops **is compulsory**.

Core Modules: The Core modules, one Trinity Elective and two Open modules specified below are mandatory. In the second semester, students have the choice of taking one of the specified Chemistry or Physics Open modules**.**

Assessment and Examination Procedures:
Modules may be assessed by end-of-semester examination and/or continuous assessment. Some modules are assessed by a 50:50 combination of continuous assessment and an examination (in a 1-hour exam), such as in PYU33P02 in recent years. Further information relating to the assessed components and composition of written papers will be given in the Junior Sophister Nanoscience Orientation issued to rising Junior Sophisters. Examined modules may include continuous assessment components. Junior Sophister marks contribute 30% of the final degree Moderatorship mark.

Senior Sophisters:
The Senior Sophister year consists of lectures, tutorials and a capstone research project, as listed below. The independent capstone research project is pursued during the first nine weeks of the first semester, in an internationally recognised laboratory that specialises in aspects of nanoscience, physics, chemistry or advanced materials, either on campus or in a facility off-campus. Projects external to Trinity College are either hosted by cognate universities or research institutes. Projects are also hosted by the Schools of Chemistry and Physics and by CRANN and PIs within AMBER.

Core Modules: The research project and several other modules are designated as core modules. These core modules total 45 credits, but the remaining 15 credits of the Senior Sophister year in Nanoscience are made up from among several Open modules of either 5 or 10 credits in size.

Assessment and Examination Procedures:
Modules may be assessed by end-of-semester examination and/or continuous assessment. Further information relating to the assessed components and composition of written papers will be given in the Senior Sophister Nanoscience Booklets issued to rising Senior Sophisters. Assessment of the full-time research project (PYU44NP2) will be performed in Semester 2. Problem Solving in Nanoscience (PYU44NP5) will be examined at the end of Semester 1. Examined modules may include continuous assessment components. The 10-credit lecture module PYU44N02 is examined in part in semester 1, with the majority of the assessment by continuous assessment and examination in Semester 2. Senior Sophister marks contribute 70% of the final degree Moderatorship mark.

Junior Sophister Nanoscience Course Structure Diagram

The Junior Sophister course structure is diagrammatically illustrated below:

<table>
<tr><th colspan="3">Junior Sophister TR061 – NANOSCIENCE</th></tr>
<tr><th colspan="3">40 Credits core + 20 Credits Open modules or Trinity Elective modules</th></tr>
<tr><td rowspan="5">Core Modules (40 credits)</td><td>Semester 1: Core</td><td>Semester 2: Core</td></tr>
<tr><td>PYU33P01: Quantum Mechanics I (5 credits)</td><td>CHU33107: Organometallics and Coordination Chemistry (5 credits)</td></tr>
<tr><td>CHU33405: Analytical and Computational Methods (5 credits)</td><td>CHU33307: Solid State Materials and Modelling (5 credits)</td></tr>
<tr><td colspan="2">PYU33NP3: Nanoscience Physics Laboratory (10 credits)</td></tr>
<tr><td>CHU33409: Analytical and Computational Methods Workshops (5 credits)</td><td>CHU33603: Practical in Physical Chemistry and Nanoscience (5 credits)</td></tr>
<tr><td rowspan="4">Open or Trinity Elective Modules (20 credits)</td><td>Semester 1: Open modules both core</td><td>Semester 2: Open – choose 1 of 2 and Trinity Elective</td></tr>
<tr><td>* PYU33P03: Condensed Matter I (5 credits)</td><td>PYU33P04: Semiconductor Physics (5 credits)</td></tr>
<tr><td>* PYU33P02: Electromagnetic Interactions I (5 credits)</td><td>CHU33105: Chemistry of Polymers and Macromolecules (5 credits)</td></tr>
<tr><td>* Indicates a mandatory selection No Trinity Elective available in Semester 1.</td><td>Trinity Elective (Nanoscience students obliged to take a TE in S2) (5 credits)</td></tr>
</table>

A Nanoscience student must take their one required Trinity Elective in Semester 2. In Semester 2 the choice of Open module is then between PYU33P04 (Semiconductor Physics) and CHU33105 (Chemistry of Polymers and Macromolecules).

A Nanoscience student cannot choose to take a second Trinity Elective. The requirement by College for these students for 10 Elective credits is met between the JS Trinity Elective in Semester 2 and the SF module in the History Philosophy and Ethics of Science.

Junior Sophister Nanoscience Core Modules **40 credits**

PYU33P01 Quantum Mechanics (S1) **5 credits**
This module covers solution of the Schrödinger Equation in specific topics, such as angular momentum and the hydrogen atom.

CHU33405 Analytical and Computational Methods (S1) **5 credits**
This module introduces the student to instrumental methods in analytical chemistry and to modern computational tools to understand chemical structure and interpret spectroscopic results.

CHU33307 Solid State Materials and Modelling (S2) **5 credits**
This model introduces the student to the fundamental aspects of solid-state materials and the modelling of them. It will focus on the electronic structure and defects and how these can be used to influence the properties of materials and hence create functional materials.

CHU33409 Analytical and Computational Methods Labs/Workshops (S1) **5 credits**
In this module students complete a range of experiments in advanced chemical analysis, spectroscopic and other characterisation techniques.

CHU33107 Organometallics, Coordination Chemistry & Inorganic chemistry (S2) **5 credits**
The aim of this module is to develop an understanding of the main methods of synthetic organometallic chemistry, fundamental structure-reactivity relationships, and concepts of bonding and structure, functional group chemistry, thermodynamics and kinetics.

CHU33603 Practical in Physical Chemistry and Nanoscience (S2) **5 credits**
In this module students complete several nanoscience and physical chemistry experiments.

PYU33NP3 Practical in Nanoscience (S1 & S2) **10 credits**
In this module students complete several advanced experiments in Nanoscience and Physics together with a practical training in Advanced Nanoscience. It also includes components involving training in communication skills, personal and career development, and requires attendance at Nanoscience related School Seminars in Schools of Physics and Chemistry.

Junior Sophister Nanoscience Open Modules and Trinity Electives **20 credits**

PYU33P02 Electromagnetic Interactions I (S1) **5 credits**
This module covers the fundamentals of electromagnetic theory together with quantum optics and lasers. (This is a mandatory module)

PYU33P03 Condensed Matter I (S1) **5 credits**
This module introduces condensed matter concepts such as crystal structure and thermal and electronic properties of matter. (This is a mandatory module).

Trinity Elective (S2 only) **5 credits**
Details on Trinity Electives are found at: https://www.tcd.ie/trinity-electives/.
Nanoscience students **must** take a TE in Semester 2. They cannot take two TEs.

PYU33P04 Semiconductor Physics (S2) **5 credits**
This module covers the physics of semiconductors and the construction, fabrication and application of semiconductor devices.
OR

CHU33105 Chemistry of Polymers and Macromolecules (S2) **5 credits**

This module introduces the student to polymer and macromolecular chemistry. Polymer-based materials are an important component of many devices and products.

Senior Sophister Nanoscience

Course Advisor: Prof Matthias Moebius (mobiusm@tcd.ie)

Senior Sophister Course Structure Diagram

<table>
<tr><th colspan="4">Senior Sophister TR061 – NANOSCIENCE</th></tr>
<tr><th colspan="4">45 Credits Core modules + 15 Credits Open modules</th></tr>
<tr><td rowspan="5">Core Modules (45 credits)</td><td colspan="2">Semester 1: Core</td><td>Semester 2 Core</td></tr>
<tr><td colspan="2">PYU44NP2: Capstone Research Project (20 credits) – Assessment in Semester 2</td><td></td></tr>
<tr><td rowspan="3">Project only in first 9 weeks of semester 1</td><td>PYU44NP5: Problem solving (5 credits)</td><td>CHU44304: Physical Chemistry (5 credits)</td></tr>
<tr><td colspan="2">PYU44N02: Nanoscience, complex fluids and polymers (10 credits)</td></tr>
<tr><td></td><td>CHU44004: Inorganic chemistry (5 credits)</td></tr>
<tr><td rowspan="8">Open Modules (15 credits)</td><td colspan="2">Semester 1: Open modules</td><td>Semester 2: Open modules</td></tr>
<tr><td colspan="2" rowspan="7">Take 2 or 3 Open modules which total 15 credits</td><td>PYU44P13: Magnetism & Superconductivity (5 credits)</td></tr>
<tr><td>PYU44P06: Modern Optics (5 credits)</td></tr>
<tr><td>PYU44P05: Electromagnetic Interactions II (5 credits)</td></tr>
<tr><td>PYU44P17: Energy Science (5 credits)</td></tr>
<tr><td>CHU44167: Advanced Physical Chemistry (10 credits)</td></tr>
<tr><td>CHU44005: Advanced Inorganic Chemistry (10 credits)</td></tr>
<tr><td>CHU44705: Advanced Computational Chemistry (10 credits)</td></tr>
</table>

The PYU44NP2 capstone research project takes place in the first nine weeks of Semester 1. This may be extended to 12 weeks in some circumstances, pending approval by the course director. The assessment of the research project is in Semester 2.

The remaining three weeks of Semester 1 has tutorials associated with the PYU44NP5 Problem Solving module, which is examined at the end of Semester 1. Lectures associated with the core PYU44N02 module begin in the last three weeks of Semester 1, and are

examined in part in semester 1, with the majority of the module's assessment by continuous assessment and examination in Semester 2. All other modules, whether mandatory or optional, occur wholly within Semester 2 and are examined at the end of Semester 2.

Senior Sophister Nanoscience Core Modules **45 credits**

PYU44NP2 Nanoscience Research Project (S1 and S2) **20 credits**
This module consists of a 9–12-week independent research project. The project is pursued in an internationally recognised laboratory that specialises in aspects of nanoscience, advanced materials or semiconductor processing. The project may be hosted within the School of Chemistry, School of Physics, CRANN, or at an approved international host institution. Submission of report and presentation of results is in Semester 2.

PYU44NP5 Problem Solving in Nanoscience (S1) **5 credits**
This module involves general problem-solving and scientific comprehension in nanoscience, advanced materials or semiconductor processing.

PYU44N02 Nanoscience, Complex Fluids and Polymers (S1&S2) **10 credits**
This module covers nanoscience, and the modified properties of nanoscale matter, its fabrication and potential applications together with the rheology and behaviour of liquids as applied to microfluidic systems and a detailed overview of polymer physics.

CHU44304: Physical Chemistry (S2) **5 credits**
The student will be introduced to statistical thermodynamics and its applications in chemistry, integrating this topic with kinetics, classical thermodynamics and quantum chemistry covered in previous years. The second part of the module will cover elements of soft matter and macromolecular and colloid chemistry.

CHU44004: Inorganic Chemistry (S2) **5 credits**
The student will be introduced to advanced synthetic methods in materials chemistry. The module focuses on the understanding of the fundamental concepts of structure-property relationships to design materials for specific applications (e.g. alloys, ceramics, glasses, inorganic polymers and various composite materials). The second part of the module will introduce the students to the molecular chemistry of the f-block elements (lanthanides and actinides).

Senior Sophister Nanoscience Open Modules **Options must total 15 credits**

PYU44P13 Magnetism and Superconductivity (S2) **5 credits**
This module covers magnetism, magnetic materials, and introduces superconductivity.

PYU44P06 Modern Optics (S2) **5 credits**
This module covers optical communications and nonlinear optics involving lasers.

PYU44P05 Electromagnetic Interactions II (S2) **5 credits**
This module covers electromagnetic wave phenomena together with the optical properties of materials.

PYU44P17 Energy Science (S2) **5 credits**
This module consists of the physics behind key technologies for energy generation.

CHU44167 Advanced Physical Chemistry (S2) **10 credits**
The student will be introduced to advanced topics in physical chemistry that integrate and build on core concepts of kinetics, thermodynamics and quantum chemistry covered in core physical chemistry modules. Topics will include: (a) electrochemistry and its applications to energy devices for sustainability, (b) photochemistry and spectroscopy, and (c) surface and interfacial chemistry, including catalysis for the environment.

CHU44005 Advanced Inorganic Chemistry (S2) **10 credits**
This module covers aspects of advanced coordination, organometallic and bioinorganic chemistry. It focuses on structure-property relationships and outlines characterisation techniques for bioinorganic systems. In addition, the module will cover the synthesis, structural chemistry and physicochemical properties of (i) molecular crystals and (ii) copper oxide superconductors, emphasizing the interplay between composition, structure and properties.

CHU44705 Advanced Computational Chemistry (S2) **10 credits**
This module will cover the main computational quantum chemistry methods and computational techniques, including optimisation and molecular dynamics, used in the modelling of structure, chemical reactivity and electronic properties of molecular systems and solid crystals. The performance and suitability of these methods for different applications will also be analysed and discussed. In addition, lectures will be complemented with computational practicals to see the direct application of these methods to specific scientific questions.

Nanoscience Moderatorship Learning Outcomes

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

- Articulate in written and oral form a foundation level of knowledge and understanding of Physics, Chemistry and Mathematics.

- Apply key concepts of Physics and Chemistry to Nanomaterials.

- Design, perform and analyse the results obtained from experiments in materials' physics and chemistry, using modern physical and chemical experimental methodologies and instrumentation, with particular reference to materials and nanomaterials.

- Demonstrate skills in problem-solving, critical thinking and analytical reasoning, and be able to effectively communicate the results of their work to chemists, physicists, material scientists and others, both verbally and in writing.

- Use modern library searching and retrieval methods to obtain information pertinent to the identification and solution of problems in the physics and chemistry of materials, and the exploration of new research areas.

- Work effectively and safely in a laboratory environment operating within the proper procedures and regulations for safe handling and use of chemicals and instruments.

- Design and perform appropriate experiments to address materials' physics, chemistry and nanoscience problems and analyse the results.

- Update their knowledge and be able to undertake further study with a high degree of autonomy.

Important information

Attendance

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

Students must attend College during the teaching term. They must take part fully in the academic work of their class throughout the period of their course. Lecture timetables are published through my.tcd.ie, and on school or department notice-boards or in Blackboard before the beginning of Michaelmas teaching term. The onus lies on students to inform themselves of the dates, times and venues of their lectures and other forms of teaching by consulting these timetables.

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

Student Services

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 and Appointments

The Senior Tutor's Office is open for student appointments between 10.30am - 12.30pm and 2.30pm - 4.00pm Monday to Friday ONLY (email stosec@tcd.ie to arrange an appointment).

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?

You should visit your Tutor whenever you are worried or concerned about any aspect of College life or indeed your personal life, especially if it is affecting your academic work. The conversation with your Tutor takes place in strictest confidence. Unless you give him/her permission to do so, s/he will not divulge information given to them to anybody, whether a member of College or to anyone outside College (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 Services-**
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 Services – contact details are available via the following webpage:
https://www.tcd.ie/disability/contact/

Learning Development
Student Learning Development offers support in a variety of study and learning skills including essay writing, exam preparation, study skills, self and time-management and note taking. Mechanisms of support are workshops, individual appointments and drop-in clinics.
https://www.tcd.ie/sld/

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

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

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

Useful College Websites:

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

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

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

Student Accommodation
https://www.tcd.ie/accommodation/

Dates to note

Event(s)	Date(s)
Closing date for submission of Mod Preferences	18th April 2025
Semester two assessments session	22nd April to 2nd May 2025
Publication of Science examination results	29th May 2025
Publication of First Round Sophister Places	Tuesday 8th July 2025
Reassessment Examinations	25th August to 29th August 2025 (TBC)
Publication of Second Round Sophister places	10th September 2025 (TBC)
Semester one starts	15th September 2025
Semester one ends	5th December 2025
Semester one examinations	15th December to 19th December

Teaching term dates 2025-26

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

October bank holiday – Monday 27th October 2025
February bank holiday – Monday 2nd February 2026
St Patrick's Day - Tuesday 17th March 2026
Good Friday – 3rd April 2026
Easter Monday – 6th April 2026

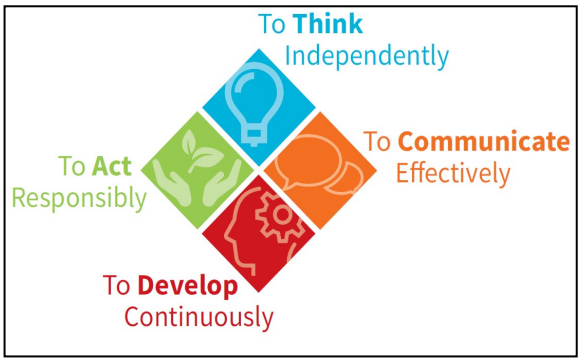
Dates are correct at time of publication, however; they are subject to change in line with College policies and procedures. All changes will be reflected on the Science Course Office webpages: www.tcd.ie/Science and on the College Calendar website: https://www.tcd.ie/calendar/academic-year-structure/academic-year-structure.pdf

Graduate Attributes

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

The four Trinity Graduate Attributes are:

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



Why are the Graduate Attributes important?

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

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

How will I develop these Graduate Attributes?

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

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

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

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

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 anemergency, **dial Security Service 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 always telephone extension 1999 (+353 1 896 1999) in case of an emergency. Should you require any emergencyor rescue services on campus, you must contact Security Services. This includes chemical spills,personal injury or first aid assistance. It is recommended that all 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/asses s-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
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.
Equality, Diversity and Inclusion	https://www.tcd.ie/equality/
Prizes, medals, and other scholarships	https://www.tcd.ie/calendar/undergraduate-studies/prizes-and-other-awards.pdf
Teaching and Learning Study Abroad	https://www.tcd.ie/study/study-abroad/
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 & events	https://www.tcd.ie/Science/careers/ For further information refer to School/Discipline Handbooks.
Attendance Requirements	Calendar, Part II, General Regulations and Information,Section II, Items 17-23 Calendar, Part III, General Regulations and Information,Section I 'Attendance and Off-Books'; Section II 'Attendance'; Section III 'Attendance, Registration, Extensions'; Section IV
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 (UG only) – Academic Registry	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
GradIreland Career advice, graduate jobs and internships	https://gradireland.com/