School of Physical and Chemical Sciences

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

General Course Information

CHEM 114
Introductory Chemistry

0.1250 EFTS 15 Points
First Semester 2025

Description
Chemistry plays an essential role in the modern world; we are dependent on chemistry to provide interesting new materials, medicines, dyes and a host of other things. We also need the principles of chemistry to understand many of the phenomena of the world around us, including how life works.
You will be studying examples of chemistry in everyday life, especially associated with biology and materials. By uncovering the basis of the world around us, you will develop the core skills of chemistry which can be applied in further chemistry or in other fields.

This course runs during the first semester and counts 15 points towards any Bachelor degree. It is an introductory course in General Chemistry for students not majoring in Chemistry, *e.g.* for students majoring in Biological Sciences or Forestry. Students with little or no prior background in Chemistry, *i.e.* fewer than 14 credits in NCEA, can use CHEM114 as an entry point to higher level Chemistry and Biochemistry courses.

Background Knowledge
There is no prerequisite. The students doing this course will have varied backgrounds: some may have done a reasonable amount of chemistry at schools whilst others may have done none! We will not assume chemical background. The course will also be gentle in its approach to maths and will not assume a strong maths background. However, if you have absolutely no chemistry or maths knowledge you will need to be prepared to do some extra background work.

Course Coordinator
Sarah Masters, School of Physical and Chemical Sciences
Julius von Haast (JvH) Room 633, ext 94229, sarah.masters@canterbury.ac.nz
E-mail if you have queries about the course and cannot find the answer in this document or on the LEARN page.

Assessment
Term test: 25% (Refer to MyTimetable or the CIS; details to be advised)
Laboratory: 10%
BestChoice: 15% (Online revision exercises; http://bestchoice.net.nz/)
Final examination: 50% (Details to be advised)
Note: To pass this course you must achieve at least 40% in the final exam component and achieve at least 50% in both the laboratory and BestChoice components. Attendance at all laboratories is compulsory.

Communication
We will communicate with you though the LEARN news feed. Ensure you check this once a day or receive the emails. There is important information in these about assessment and changes, please read them carefully and enter information into your diary/calendar as soon as it is received.

Timetable

Lectures and Problem-Solving Sessions: Four face to face sessions per week; details to be confirmed on 'My Timetable' and the Web.

Academic Staff

Prof. Sarah Masters	JvH 633	sarah.masters@canterbury.ac.nz
Prof. Richard Hartshorn	JvH 630	richard.hartshorn@canterbury.ac.nz
Dr. Timothy Allison	JvH 517	timothy.allison@canterbury.ac.nz

The lectures will be presented in five blocks, see below for more details of each lecture block. A breakdown of workload expectations for CHEM114 is given in more detail below.

Problem-solving

Problem-solving is an important skill which will be developed in lectures, laboratories, problem-solving classes and by use of the BestChoice website. These skills will be examined at various stages during the course.

BestChoice

Students are expected to complete online tutorial assignments on the BestChoice website (http://bestchoice.net.nz/. These quizzes are worth a total of 15% of your final mark. Students who complete all of these have a far greater success rate in this course. Details will be given to you *via* LEARN in Week 2.

- **One third of the BestChoice assignment (covering topics in Weeks 1 – 4 of the course) must be completed prior to the course test in Week 6, worth 5% (BestChoice 1).**
- **The remaining two thirds must be completed by the end of Term 2, worth 10% (BestChoice 2).**

Further written details will be provided on the LEARN page.

Textbook

The textbook for all of first year chemistry is Chemistry^3 by Burrows, Holman, Parsons, Pilling and Price (Editions 1 – 4 are acceptable for the course). This is a useful source of basic chemical information and ideas. It is an OPTIONAL purchase for CHEM114 students. Students intending to study chemistry further should purchase the book. It is used for CHEM111, CHEM/BCHM112, CHEM211 and CHEM/BCHM212. Multiple copies of this book are held on 3-hour reserve in the Library. Students enrolled in the course can buy the text from the bookshop for a discounted price.

Web-based resources

Various learning resources for this course are available via the University of Canterbury's LEARN web site – http://learn.canterbury.ac.nz/. The LEARN site will also be used regularly as a means of communication and information distribution for all your Canterbury courses. You should familiarise yourself with LEARN as soon as possible. If you are having problems, please go to the student help hub in the Library for assistance.

Workload

In total, a 15-point course requires approximately 150 hours of work (some students may need more). A guideline is that each course should need at least 10 hours per week including contact hours.

Here is a guideline for how to spend these hours for CHEM114:

Lectures	3 hours per week (36 hours total)
Tutorials (labelled as lectures on the timetable) (preparation plus class)	2 hours per week (24 hours total)
BestChoice / Material revision	3 hours per week (36 hours total)
Laboratories (Pre-lab video and Pre-lab quiz questions, lab & Post-lab quiz)	4 hours per fortnight (20 hours total)
Test (preparation; workshop; test time)	12 hours total
Exam (preparation; workshop; exam time)	22 hours total

Success at university depends on YOU. You do not learn by osmosis, you need to engage in the lecture material, do the problems yourself and put **significant effort** into revising material prior to tests and examinations.

LABORATORY INFORMATION

All CHEM114 laboratory sessions are compulsory and assessed; worth 10% of your total mark.

If your overall completion of laboratories is judged unsatisfactory you will not be given a pass in the laboratory course and will FAIL CHEM114.

Laboratory Coordinators

For all queries, please contact the lab coordinators on the email address: chemistry114@canterbury.ac.nz

Laboratory allocation

- Lab stream allocations this year have been pre-assigned based on your timetable. Once allocated to a lab stream you may only attend your assigned stream, during which your attendance will be recorded. Please refer to MyTimetable to see what laboratory class you have been assigned.
- If you enrol late, your lab session does not appear on your timetable, or there is a clash, you will also need to contact the laboratory coordinators to be assigned to a lab stream (chemistry114@canterbury.ac.nz).
- **The first laboratory is held in Week 3**. The laboratories will be held in 419 on Level 4 of the Ernest Rutherford Building. **Attend the laboratory stream to which you are assigned.**

Laboratory Organization

Each laboratory is overseen by a laboratory supervisor. They will be accompanied by demonstrators and together they will be responsible for grading your lab assignments and answering queries. If you encounter difficulties during the laboratory please consult any demonstrator, the supervisor or the laboratory coordinators.

Dress for the Laboratory

Safety glasses/ laboratory coats are not provided and can be purchased. Follow the instructions on the LEARN page. Approved safety glasses and laboratory coats may be purchased from the University.
To purchase: go to: https://www.canterbury.ac.nz/study/academic-study/science/science-shop

Laboratory coats can be collected before the start of term on the following dates, please ensure you bring your Student ID with you, and your receipt number. See LEARN page for information about collection dates and times.

TIP: Coats need to be tried on for fit so do not leave pick up until the last minute before your lab class.

You must put **safety glasses on before entering any laboratory** and they must be always worn. If you normally wear prescription glasses, you must either wear clear plastic safety glasses over them or they must have lenses of plastic or toughened glass and be fitted with side-protectors.

Laboratory coats must be always worn in the laboratory and be done up. Suitable footwear must be always worn. For safety reasons, this means shoes that cover all your feet. Jandals, Roman sandals and backless shoes are NOT acceptable.

Laboratory Manuals

An electronic copy can be downloaded from the Course Information and Assessment sections of the CHEM114 AKO|LEARN website and hardcopies will be available for use in the laboratory. Please download the electronic copy for use outside the lab**.**You are required to read and understand the introduction, theory, and experimental sections for each experiment in your laboratory manual BEFORE coming to the lab.

Safety Quiz

All students must complete an online Safety Quiz prior to their first laboratory. More details of this will be given in your lectures and on the CHEM114 Learn site.

Laboratory Assessment

During the course you will be expected to become proficient at common laboratory techniques such as weighing, titrating, making observations, recording data, making calculations and interpreting results. Your supervisor and demonstrators will assess your performance in these areas, and your general attitude, application and organisation in the laboratory; i.e. your weekly mark will not purely be on the basis of what is written in your report sheet. During the first laboratory session, you will be instructed about laboratory procedures and safety.

Each week you will be supplied with a lab report sheet for the weeks experiment which you need to complete in the lab. Each lab will have 8 CHECKPOINTS that are marked off as you complete them by the demonstrators. **You must retain your lab report sheets because: (a) they represent proof that you attended the laboratory that week and (b) some of the test/exam questions will be based on laboratory experiments.**

Experiment Videos, Pre-lab Quiz Questions and Post-lab Quiz Questions
Experiment videos (and skills videos) and the pre-lab quiz will be available on LEARN before each laboratory. You will be expected to read the experiment in the lab manual, read the experiment 'Information file', watch any experiment videos (and skills videos) and answer the pre-lab quiz questions BEFORE attending your laboratory class (more details will be provided on the CHEM114 AKO|LEARN page before each laboratory class).
After each laboratory class you MUST complete post-lab quiz questions, which are designed to reinforce any concepts and learnings from the lab experiment. The **pre-lab and post-lab quizzes** are COMPULSORY and worth part of your lab mark (more details on these are provided in the laboratory sections on LEARN).

The Pre- & Post-laboratory quizzes will close at 5 PM on MONDAY of the CHEM114 lab week.

Attendance at Laboratory Classes
You are expected to attend every laboratory session. A satisfactory record of attendance and performance at laboratory classes is a condition for passing the course. Students who are unable to attend their laboratory in a particular week because of an unavoidable commitment should, in the first instance, contact the laboratory coordinators (chemistry114@canterbury.ac.nz) and attempt to arrange attendance at one of the other times that same week. (Please note that you cannot make up the missing lab the following week.)

If you miss the safety talk at the start of the laboratory you will not be able to do the experiment and will be assigned zero marks for that session. Ensure you arrive in good time for the start of class.

Unexcused Absences
Unexcused absences will be assigned a mark of zero for the experiment and will degrade your final mark. This will constitute an unsatisfactory record and result in you failing the laboratory requirement and hence CHEM114.

Absence Due to Illness
This will be excused, provided a medical certificate from a registered medical practitioner, registered dental surgeon, registered midwife or a student counsellor is presented at the next laboratory attended. Multiple medical certificates may constitute unsatisfactory laboratory performance and result in you failing the laboratory requirement and hence CHEM114.

Absence Due to Attendance at a National Sporting or Cultural Event
Contact the course coordinators (chemistry114@canterbury.ac.nz) well in advance of the event and with suitable documentation. You may be excused attendance at that week's laboratory, but it is not guaranteed.

Bags
These may be stored in lockers outside the lab. They must not be taken into the lab although computers may be stored on the side benches, and it is recommended valuables should remain with you.

Food or drink
This may not be consumed in the laboratory. Water bottles are not allowed in the laboratory.

Smoking and vaping
This is prohibited everywhere on the university campus.

No headphones or ear buds to be worn in laboratories.

Permitted Personnel
Only those students who are enrolled in CHEM114 are permitted to enter the laboratories. You must not bring anyone else into the laboratories. Anyone waiting for you must do so outside the laboratory rooms.

Hair
Must be tied up and securely fastened off the face or put securely under a beanie.

Goal of the Course
This course will develop a foundation for understanding molecular systems and progressing in sciences that utilize chemical understanding.

Learning Outcomes
- Develop problem-solving and data analysis skills
- Demonstrate an understanding of the world at an atomic scale
- Show an understanding of scientific nomenclature
- Describe the aqueous chemistry that underpins life
- Demonstrate an understanding of chemical experimentation, including data collection and analysis
- Explain the physical basis of chemical reactions, including basic thermodynamics and kinetics

Topics in Block 1

Introduction to Atoms
- The atomic hypothesis and atomic scale
- Elements and element symbols
- Scientific notation
- Kinetic theory of matter: the nature of solids, liquids and gases
- The nature of, and distinctions between, physical and chemical processes
- Atomic structure: electrons, protons and neutrons
- The importance of electromagnetic forces in chemistry
- Atomic masses and isotopes – mass spectrometry
- The mole concept and especially calculations involving moles
- Introduction to electromagnetic radiation and energy
- Light absorption and emission and introduction to its application to electronic spectroscopy
- Bohr model of the atom and the quantization of electron energy
- Electronic configurations
- Atomic absorption spectrometry

Chemical reactions, periodicity and bonding
- Mixtures; Compounds; Elements
- Ionization; ions; Cations; Anions
- Chemical reaction; Electron transfer
- Salts; Ionic bonding
- Periodic Table; Period; Group
- Alkali metals; Alkaline earth metals
- Non-metals; Halogens
- Molecules; Covalent bond; Single bond; Double bond
- Electron shell; Electron configuration
- Core electrons; Outer shell; Octet rule; ionization energy

Material properties and bonding
- Electronegativity; Polar bonds; Dipoles; Hydrogen bond
- Valence Shell Electron Pair Repulsion Theory (VSEPR) up to 4-coordinate centres; Tetrahedral geometry
- Covalent molecules and network structures
- Intermolecular forces
- Polar and non-polar molecules; solvents and solutes

Topics in Block 2

There are two facts that we know about the chemistry of life; it consists largely of organic molecules and their reactions in water. In the second block of lectures we will examine the chemistry of water and molecules dissolved in water, i.e. *aqueous chemistry*. We will look at the concept of chemical equilibria and particularly apply this to acid base chemistry. Specifically, we will examine the topics shown below.

Aqueous Chemistry

- Structure and properties of water
- Dissolution process
- Ions in solution
- Equilibria and Equilibrium constants (K)
- Solubility rules
- Dissolved CO_2

Equilibria

- The equilibrium constant (K)
- The reaction quotient (Q)
- Le Chatelier's Principle

Acid Base Chemistry

- Acids and bases; Conjugate acids and bases
- Acid strength, K_a and pH
- Buffers
- Titration curves
- Indicators

Topics in Block 3

Thermodynamics and Kinetics

These lectures will introduce more quantitative ways of looking at physical and chemical processes. We will discuss the energy changes that accompany different processes and the way that that is reflected in the changes in enthalpy or "heat", ΔH (enthalpy changes are a technical term for discussing energy, or heat, changes at constant pressure). We will note the distinction between the thing undergoing the change, the system, and the rest of the universe, the surroundings. Processes ("systems") which take in energy are endothermic, whereas those which give our energy are exothermic. As examples, processes which involve breaking chemical bonds are endothermic, whereas those which form chemical bonds are exothermic. The examples that we will study include phase transitions of water (ice melting and water boiling); the energetics of forming an ionic salt from the constituent elements; and the energetics of dissolving ionic solids in water. Other topics that will be covered include: the First Law of Thermodynamics, Hess's Law, and Born-Haber cycles.

Processes may go forwards or backwards depending on the conditions (e.g. ice can melt or water can freeze). The direction in which processes tend to occur is the basis of the Second Law of Thermodynamics – favourable processes involve an increase in the disorder of the universe. This is quantified by the thermodynamic term entropy, S. We will consider entropy in a qualitative way to predict whether a process is likely to occur.

Chemical Kinetics

Chemical processes are generally speeded up by increasing the concentration of reactants and/or the temperature. These features can be understood in terms of the collision theory of chemical reactions. Collisions between molecules are more frequent if the concentration of molecules is greater. We will examine how the rate of a reaction depends on the concentration of one or more reactants in different systems and methods that can be used to quantify and describe this relationship.

Topics in Block 4

We will look at oxidation – reduction processes.

Redox Chemistry

- Oxidation
- Reduction
- Oxidation numbers
- Oxidation states
- Balancing redox equations

Topics in Block 5

We will explore in more detail what organic molecules are, their properties and develop our understanding of the types of chemicals that are important in biological systems.

Organic Chemistry

- Hydrocarbons
- Alcohols and ethers
- Aldehydes and ketones
- Carboxylic acids
- Esters and Lipids
- Amines and Amides
- Synthetic polymers
- Zwitterions
- R-groups
- Peptides and protein structure

GENERAL INFORMATION | TE KIMI MŌHIOHIO 2025

Policy on 'Dishonest Practice'| Ngā Takahitanga me ngā Tinihanga

The University has strict guidelines regarding 'dishonest practice' and 'breach of instructions' in relation to the completion and submission of examinable material. In cases where dishonest practice is involved in tests or other work submitted for credit, a department may choose to not mark such work – see the online guidelines in relation to 'Academic Integrity'.

The School of Physical and Chemical Sciences upholds this policy. It considers plagiarism, collusion, copying and ghost writing – all detailed below – to be unacceptable and dishonest practices:

- ***Plagiarism | Tārua Whānako*** is the presentation of any material (text, data or figures, on any medium including computer files) from any other source without clear and adequate acknowledgement of the source.
- ***Collusion*** is the presentation of work performed in whole, or in part, in conjunction with another person or persons, but submitted as if it has been completed by the named author alone. This interpretation is not intended to discourage students from having discussions about how to approach an assigned task and incorporating general ideas that come from those discussions into their own individual submissions, but acknowledgement is necessary.
- ***Copying*** is the use of material (in any medium, including computer files) produced by another person or persons with or without their knowledge and approval. **This includes copying of the lab reports (raw data may be shared within the group if permitted or required by the experiment) – data analysis and interpretation of obtained results MUST be performed individually.**
- ***Ghost writing*** is the use of other person(s) (whether with or without payment) to prepare all or part of an item of work submitted for assessment.
- ***Generative AI Tools:*** **The following shall apply to all assessments in this course, except where a lecturer has specifically stated otherwise in written instructions for an assessment.**

In all assessments, you are strictly prohibited from using generative artificial intelligence (AI) to generate any materials or content related to the assessment. This is because students are expected to solve problems and demonstrate knowledge and understanding without the assistance of AI. The use of AI-generated content is not permitted and may be considered a breach of academic integrity. Please ensure that all work submitted is the result of your own human knowledge, skills, and efforts.

Special consideration of assessment | Ngā Pairuri Motuhake

'Special Consideration' for an item of assessment is for students who have covered the work involved but have been prevented from demonstrating their knowledge or skills at the time of the assessment due to unforeseen circumstances, whether illness, injury, bereavement, car crash or any other extenuating circumstance *beyond one's control*. Special Consideration for a test/exam may be because a student has not sat it or has done so with impaired performance. Applications can be submitted via the above link and must be made **no later than five working days after the assessment due date**. Note that special consideration is **not available for items worth less than 10% of the overall course mark**. In the case of illness or injury, medical consultation should normally have taken place either shortly before or within 24 hours after the due date for the required work or test/examination.

Note that you may be required to sit a special exam or your grade may not be changed if there is insufficient evidence of your performance from other invigilated assessment items in the course. ***You have the right to appeal any decision.***

It is important to understand that Special Consideration is only available *where course work has been covered*, and the inability to demonstrate this fully is both *no longer possible* AND is due to *unexpected circumstances beyond one's control*. Thus Special Consideration **is NOT available for:**

- essays, assignments or quizzes where an extension of time is available to complete the assessment item (see below for the process to involved);
- missed lectures during the semester;
- experiencing examination anxiety;
- having several examinations or assessments close together;
- known impairment, such as chronic illness (medical or psychological), injury or disability unless medical evidence confirms that the circumstances were exacerbated, despite appropriate management, at the time of assessment;
- mistaking the date or time of an examination (this is a circumstance one can control!);
- failing to turn up to an examination or test because of sleeping in (a circumstance as above!);
- where applications are repeatedly made for the same or similar reason, then the application may be declined on the grounds that the reason is not unexpected;
- where the application is made at the time of the assessment but the supporting documentation is received significantly after this date or after the date results are released; or
- the application is made following the release of results (unless under exceptional circumstances).

Extensions of deadlines | Tononga Wā Āpiti

Where an extension may be granted for an assessment item, this will be decided by application to the course co-ordinator and/or the lecturer concerned.

Late withdrawal from a course

If you are prevented by extenuating circumstances from completing the course after the final date for withdrawing from the course, you may apply for special consideration for late discontinuation. For details on special consideration, or to make an application, refer to the Examinations Office website http://www.canterbury.ac.nz/exams/. Applications must be submitted ***within five days*** of the end of the main examination period for the semester.

Missing of tests | Te Matangaro i ngā Whakamātautau

In rare cases a student will not be able to sit a test. In such cases, the student should consult with the course co-ordinator to arrange alternative procedures. **This must be done well in advance of the set date for the test.**

Past tests and exams

Past tests can be found on our Chemistry Undergraduate website. Past exams can be found on the Library website.

Submission of reports and assignments

Reports (including lab reports) and assignments should be handed in on time. Extensions will be granted only in exceptional circumstances (such as illness or bereavement). If an extension is required, as early as possible you should request it from the lecturer concerned.

Note: If you do not submit an assignment for assessment, you will be allotted zero marks, which will affect your final result. You should ensure that you pick up marked assignments and keep them until the end of the course as evidence that the work was completed and marked in the case that either is disputed. To guard against accidental loss, it would be prudent to keep photocopies or electronic copies of anything submitted.

Late Work
Acceptance of late work for assessment will be at the discretion of the course coordinator and/or the lecturer concerned. If your assessment is likely to be late, please contact the relevant of these people ***before the assessment is due***. Never assume that an extension will be automatically granted – some courses have the policy of no late work being accepted. A commonly exercised policy is to deduct 10% of the total marks for each day that the work is late, where weekends and public holidays also count as such days.

Marks and Grades | Taumata Ako
The following numbers should be considered as a guide to the expected grades under normal circumstances.

Please note that for all invigilated assessments (tests and exams) worth 33% and above, failure to obtain a mark of at least 40% will result in a final grade no higher than an R at 100 and 200 level; in general this requirement will not be applied at 300 level, but if it is then the course coordinator will inform the class and it will result in a final grade no higher than a C–.

Grade:	**A+**	**A**	**A−**	**B+**	**B**	**B−**	**C+**	**C**	**C-**	**D**	**E**
Minimum mark %:	**90**	**85**	**80**	**75**	**70**	**65**	**60**	**55**	**50**	**40**	**0**

The School reserves the right to adjust this mark/grade conversion, up or down, to achieve consistency of assessments standards.

Reconsideration of Grades
Students should, in the first instance, speak to the course co-ordinator about their marks. If they cannot reach an agreeable solution, or have questions about their grade in a course, students should then speak to the Director of Undergraduate Studies, Assoc Prof Greg Russell. Students can appeal any decision made on their final grade. You can apply at the Registry for reconsideration of the final grade within four weeks of the date of publication of final results. Be aware that there are time limits for each step of the appeals process.

Student Accessibility Services | Te Whaikaha
Students can speak with someone at Student Accessibility Service, phone: 369 3334 (or ext. 93334), email: sas@canterbury.ac.nz).

Academic Advice
Assoc Prof Greg Russell is the coordinator of undergraduate chemistry courses. His interest is in the academic performance and well-being of all such students. Anyone experiencing problems with their chemistry courses or requiring guidance about their B.Sc. in Chemistry should get in contact with Greg.

Staff-Class Rep Liaison
Assoc Prof Greg Russell is in charge of liaison with students in chemistry courses. Your class will appoint a student representative to the liaison committee at the start of the semester. Please feel free to talk to the Academic Liaison or the student rep about any problems or concerns that you might have.

Greg Russell (greg.russell@canterbury.ac.nz, tel. 369 5129)
Director of Undergraduate Studies
School of Physical and Chemical Sciences
2025