School of Physical and Chemical Science

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 2022

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.
We will be studying examples of chemistry in everyday life, especially associated with biology and materials. By uncovering the basis of the world around us, we 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.

What background knowledge will I need?
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 knowledge you will need to be prepared to do some extra background work.

Course Coordinator
Sarah Masters, School of Physical and Chemical Sciences
Beatrice Tinsley (BT) Room 422, 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% (Will be online in 2022)
BestChoice:	15% (On-line 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 and achieve at least 50% in the laboratory and BestChoice components.

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 online sessions per week; details to be confirmed on 'My Timetable' and the Web.

Academic Staff

A/Prof. Sarah Masters	BT Room 422	(ext 94229)	sarah.masters@canterbury.ac.nz
Dr Nic Bason	ER Room 502A		nic.bason@canterbury.ac.nz

The lectures will be presented in five blocks as follows: Sarah Masters: block 1, Nic Bason: blocks 2 – 5. 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 points during the course.

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

Textbook
There will be substantial lecture notes provided with the course. 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 who intend to take further courses in chemistry should buy this textbook as it is also the text that is used for CHEM111 and CHEM112 and for the first two courses in second year. 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 of your Canterbury courses. You should familiarise yourself with LEARN as soon as possible.

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 (preparation plus class)	2 hours per week (24 hours total)
BestChoice / Material revision	3 hours per week (36 hours total)
Laboratories (Pre-lab video, lab video, write up)	4 hours per fortnight (24 hours total)
Test (preparation; workshop; test time)	10 hours
Exam (preparation; workshop; exam time)	20 hours

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 effort into revising material.

Laboratory coordinators
Dr Anthea Lees, anthea.lees@canterbury.ac.nz. Contact Anthea for morning lab session queries
Dr Justine Cottam justine.cottam@canterbury.ac.nz. Contact Justine for afternoon lab session queries.

Laboratory classes will be run online with assignments
Laboratory allocations*:* You must allocate yourself to a lab stream through MyTimetable before the laboratory classes begin. If you do not do this before the start of term you will be allocated into a laboratory class. If you enrol late and your lab session does not appear on your timetable, you will also need to contact the laboratory coordinators to be assigned to a lab stream.
These lab streams will be used for marking your on-line laboratory assignments so it's important you allocate yourself.

All CHEM114 on-line laboratory assignments are compulsory and assessed; worth 10% of your total mark.

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 on-line lab assignments, please consult any demonstrator, the supervisor or lab coordinators Anthea/Justine. We will provide you with email details for these.
Laboratory assessment: For each on-line assignment you will be supplied with a word document for the week's experiment, a PowerPoint file and videos. The assignment should be completed and submitted through an on-line portal by an advertised deadline (details will be provided through the CHEM114 LEARN laboratory page).
Laboratory manuals: will be available to download from the on-line laboratory page of the CHEM114 LEARN website.

Completion of on-line safety quiz and laboratory assignments
You are expected to complete every CHEM114 on-line assignment and to complete the CHEM114 on-line safety quiz.

If you cannot complete your assignment, you should contact the laboratory coordinators **in advance** to check that you reason is deemed valid. For an exemption, you will need to provide documented evidence **via e-mail**, *e.g*. a copy of a letter from a team manager, or funeral notice, or letter from a doctor or counsellor. You should retain the original copy of the letter and send a scanned or photographed copy by e-mail to the laboratory coordinators.

Students who are unable to complete an assignment because of any circumstances described below should, in the first instance, contact the laboratory coordinators.

Absences due to illness, injury or other medical condition will be excused only if you provide a medical certificate from a registered medical practitioner, registered dental surgeon, registered midwife or a student counsellor.
Important note: a medical certificate should be obtained **in the period around the missed lab assignment**. A retrospectively obtained medical certificate must be accompanied by evidence (e.g. a letter from a relevant medical professional) confirming that an appointment was made on or near the day of the missed lab. In all cases where a medical appointment was not made (and evidenced) around the time of the missed lab, a reason must be provided by the health professional as to why the medical certificate could not have been obtained near the time of the missed lab.

Absences due to bereavement (the death of a family member or close friend) will be excused, provided a copy of the death notice is provided.
Absence to attend a national sporting or cultural event may be excused, but you must contact the laboratory coordinators **in advance of the event** and provide any supporting documentation that is requested.
Absence due to other emergencies or other unforeseen circumstance may be excused if you **immediately** provide appropriate evidence. You need to contact the laboratory coordinators as soon as practical.
Any unexcused absences may constitute an unsatisfactory record and result in you failing the laboratory requirement and hence CHEM114. At the very least, you will be assigned a mark of zero for the assignment, which will reduce your final mark.

Exemptions*:* Students who are repeating CHEM114 may, on the basis of their results in a previous year, be exempted from attending laboratories. Students who wish to apply for exemption should contact the course coordinator by email by the end of the second week of the semester. You must obtain formal exemption to be excused from the laboratory section of the course.

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

Laboratory Safety (information for completing safety quiz)
Safety glasses of an approved design must be worn at all times in the laboratory. If you normally wear prescription glasses you must either wear safety glasses over them or they must have plastic or toughened-glass lenses and be fitted with side protectors. Safety glasses are not supplied.
You must wear approved safety glasses in the laboratory and they must be put on before entering the lab and removed after leaving lab. (**No purchase needed for chemistry on-line lab assignments)**

Laboratory coats must be worn at all times in the laboratory and should not be worn outside of the laboratory environment. (**No purchase needed for chemistry on-line lab assignments**)

Suitable footwear must be worn at all times in the laboratory. This means footwear **that is closed to spills and that covers all of your feet**. **No open-topped, open-toed, or backless footwear – and absolutely no gumboots, jandals or sandals.** Students who come to a laboratory in bare feet or unsuitable footwear will not be allowed to enter the laboratory.

Bags 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 may not be consumed in the laboratory. Water bottles are not allowed in the laboratory.
Smoking and vaping is prohibited everywhere on the university campus.

No headphones or air buds to be worn in labs.

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.

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, Ka 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 in order 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 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

Topics in Block 5

We will look at oxidation – reduction processes.

Redox Chemistry

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

GENERAL INFORMATION 2022

Chemistry Department Policy on 'Dishonest Practice'
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 ('Academic Integrity and Breach of Instruction Regulations').

The Department of Chemistry upholds this policy. It considers plagiarism, collusion, copying, and ghost writing to be unacceptable and dishonest practices:

- ***Plagiarism*** 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) (with, or without payment) to prepare all or part of an item of work submitted for assessment.

Additional Information
Special consideration of assessment*:** If you feel that illness, injury, bereavement or any other critical extenuating circumstance beyond your control has prevented you from completing an item of assessment or affected your performance in that assessment, you may apply for special consideration. Special consideration is not available for items worth less than 10% of the course. Applications for special consideration should be made **within five days** of the due date for the work or examination. In the case of illness or injury, medical consultation should normally have taken place shortly before, or within 24 hours after, the due date for the required work or the date of the test or examination. For details on special consideration, or to make an application, refer to the Examinations Office website http://www.canterbury.ac.nz/exams/. ***You have the right to appeal any decision.

Extensions of deadlines: Where an extension may be granted for an assessment item, this will be decided by application to the course co-ordinator.

Late withdrawal from the 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*:** 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: these can be found on our website using the link below:
www.chem.canterbury.ac.nz/for/undergraduate.shtml

***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.

Marks and Grades: The following numbers should be considered as a guide to the expected grades under normal circumstances. The School reserves the right to adjust mark/grade conversions, if necessary.

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, and a C- at 300 level.

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**

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 (phone 3694228). 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.

Students with Disabilities: Students with disabilities should speak with someone at Equity and Disability Service, phone: 369 3334 (or ext. 93334), email: eds@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
2022