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 2021

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 Co-ordinator
Jan Wikaira, School of Physical and Chemical Sciences
Beatrice Tinsley (BT) R 423, ext 94294, jan.wikaira@canterbury.ac.nz
E-mail me if you have any queries about the course.

Assessment

Term test:	25% (Refer to MyTimetable or the CIS; details to be advised)
Laboratory:	15%
BestChoice:	10% (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

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

Assoc. Prof. Sarah Masters	BT Room 422	(ext 94229)	sarah.masters@canterbury.ac.nz
Dr Jan Wikaira	BT Room 423	(ext 94294)	jan.wikaira@canterbury.ac.nz
Prof. Alison Downard	BTRoom 426	(ext 94228)	alison.downard@canterbury.ac.nz

The lectures will be presented in four blocks as follows: Sarah Masters: block 1, Jan Wikaira: block 2, Alison Downard: block 3, Jan Wikaira: blocks 4 & 5. See below for more details of each lecture block. Students should note that, in the Science Faculty, the average student is expected to undertake approximately 3 hours of additional study for each hour of lectures at the 100-level.

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

Bestchoice

Students will be expected to complete online tutorial assignments on the BestChoice website (http://bestchoice.net.nz/. These quizzes are worth 10% of your final mark. It has been noted that students who complete all of these have a far great success rate in this course. Details will be given to you in lectures.

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 (Edition 1, 2 or 3 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 Physical Sciences 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.

Laboratory Classes

The laboratory contact for Timetabling is Dr Anthea Lees, ER 419.
anthea.lees@canterbury.ac.nz

Laboratories times:

Lab 01	Wednesday	14:00 – 17:00
Lab 02	Thursday	09:00 – 12:00
Lab 03	Thursday	13:00 – 16:00
Lab 04	Friday	09:00 – 12:00
Lab 05	Friday	13:00 – 16:00
Lab 06	Wednesday	09:00 – 12:00
Lab 07	Tuesday	13:00 – 16:00

The first laboratory is held in Week 1. You must attend the laboratory session to which you are allocated. The laboratories are held in 419 on Level 4 of the Ernest Rutherford Building. The laboratory group (see above) to which you have been assigned is normally printed on your enrolment form and fees receipt. **Please attend the laboratory group to which you are assigned.** Come to the same stream every week. If you have not been assigned to a laboratory class or if you have a timetable clash involving the class to which you have been assigned, you should contact **Dr Anthea Lees** anthea.lees@canterbury.ac.nz as soon as possible

Dress for the Laboratory
Safety glasses and laboratory coats are not provided and can be purchased by following the instructions in the box below.

PURCHASING SAFETY GLASSES AND LABORATORY COATS

Approved safety glasses and laboratory coats may be purchased from the University. To purchase: go to https://www.canterbury.ac.nz/science/shop/. Lab coats $32, glasses $10. The collection point for purchases is inside the southern entry to the Ernest Rutherford Building, 8.30 – 10 am and 1.30 – 3.00 pm, Monday to Friday for the first two weeks of the semester.

You must put safety glasses on before entering any laboratory and they must be worn at all times. 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 worn at all times in the laboratory and be done up. Suitable footwear must be worn at all times. For safety reasons, this means shoes that cover all of your feet. Jandals, Roman sandals and backless shoes are NOT acceptable.

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

Laboratory Manuals
These will be provided to you when you collect your lab coats and safety glasses.

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 obtaining a pass in the course. Students who are unable to attend their lab in a particular week because of an unavoidable commitment should, in the first instance, contact Jan Wikaira 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.)

Unexcused absence
This may constitute an unsatisfactory record and result in you failing the laboratory requirement and hence CHEM114. At the very least, it will lead to your being assigned a mark of zero for the experiment and will degrade your final mark.

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 lab attended.

Absence due to unavoidable circumstances
Contact **Jan Wikaira**. If possible arrange attendance at one of the other times that same week. If this is not possible, she will advise you of what to do.

Absence due to attendance at a National Sporting or Cultural Event
Contact **Jan Wikaira** well in advance of the event and with suitable documentation. She may excuse your attendance at that week's laboratory, but it is not guaranteed.

Exemption
Students who are repeating the course may, on the basis of their level of performance in the laboratory in a previous year, be exempted from attending laboratories in 2021. Students who wish to apply for an exemption should contact **Jan Wikaira** before the first laboratory. Do not assume you automatically have an exemption.

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.

Pre-lab videos will be on-line before each lab. You must watch each video and answer some questions relating to it before you come to the lab. Marks for these questions will be part of your lab mark.

Each week you will complete a report sheet during the lab, and hand it in to your demonstrator before leaving. S/he will grade and return it to you at the next laboratory session. You must retain your report sheets after marking 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.

You will be assigned a mark by your supervisor for your performance in the laboratory during the course and also one by your demonstrator for your reports. (Note: the latter may be adjusted to allow for differing marking standards.)

Note: You must pass the lab course to pass CHEM114
If your overall attendance at laboratories is judged unsatisfactory you will NOT be given a pass in the laboratory course and will thus fail CHEM114. If your attendance is satisfactory but your performance is not, you may be required to take a practical examination at the end of the course.

100 Level Mentor
The 100-Level mentor is Jan Wikaira, BT423, ext 94294, jan.wikaira@canterbury.ac.nz. Jan is able to assist with timetabling laboratory queries and offer general help and advice with regard to 100-Level chemistry.

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 2021

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, Professor Alison Downard (Room 426, Beatrice Tinsley Building, 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**:** Professor Alison Downard is the coordinator of undergraduate chemistry courses. Her 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 Alison.

Staff-Class Rep Liaison**:** Professor Alison Downard 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.

Computer equipment**:** The University provides several student computer facilities. There is a suite of PCs in Ernest Rutherford which students are welcome to use OUTSIDE THE TIMES WHEN THESE COMPUTERS ARE NEEDED FOR CLASSES. Commonly used programs such as Word and Excel have been loaded onto these PCs.

Alison Downard
Director of Undergraduate Studies
School of Physical and Chemical Sciences
February 2021