School of Physical and Chemical Sciences

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

General Course Information | Ngā Whakamārama

CHEM112 / BCHM112
Structure and Reactivity in Chemistry and Biochemistry

0.1250 EFTS 15 Points
Second Semester 2024

Description | Whakamahuki
CHEM/BCHM112 covers aspects of organic and inorganic chemistry and represents half of the general chemistry first year content at UC. Students attempting CHEM/BCHM112 should have at least 14 NCEA level 3 credits in Chemistry, or CHEM114, or a B or better grade in BRDG023, or equivalent preparation approved by the Head of the School of Physical and Chemical Sciences.

Timetable | Wātaka
48 lectures, 6 laboratories (compulsory), 2 drop-in sessions.

Lectures: Please check 'My Timetable' and the Web as these can change.

Lectures will be given by:
Dr Jodie Johnston (12 lectures) e-mail: jodie.johnston@canterbury.ac.nz

Dr Chris Fitchett (16 lectures) e-mail: chris.fitchett@canterbury.ac.nz

Prof. Paul Kruger (20 lectures) e-mail: paul.kruger@canterbury.ac.nz

It is expected, in the Science Faculty, that the average student is responsible for approximately 3 hours of additional study for each hour of lecture at the 100-level.

Course Coordinator | Kairuruku Akoranga
Chris Fitchett, email chris.fitchett@canterbury.ac.nz
Email me anytime if you have any queries about the course.

Laboratory Coordinator:
Dr Justine Cottam, chemistry112@canterbury.ac.nz
Email for any laboratory queries.

Assessment | Aromatawai
Exam: 55%
Test: 20%
Laboratory: 15%
Best Choice 10%

Examination and Formal Tests | Ngā Whakamātautau Ōkawa

Test: Wednesday 14th of August at 7pm.
Rooms to be confirmed through My Timetable and the Web. The test will cover the material from the first three weeks of the course (Jodie Johnston's material).

Exam: details to be advised
The final exam will cover the material from the last eight weeks of the course. Material from the first four weeks will not be explicitly re-examined, but you will be assumed to be familiar with it.

The results for the test will be posted as soon as they become available, and your scripts will be returned to you in the first lab after the break. Your **overall grade for CHEM112-BCHM112** will be released at the end of the year, with the other University results.

Textbooks | Tuhinga

Burrows et al.; **Chemistry^3**: introducing inorganic, organic and physical chemistry; Oxford University Press; either the 1st, 2nd or 3rd edition may be used.

Prerequisites

At least 14 NCEA level 3 credits in Chemistry, or CHEM114, or a B or better grade in BRDG023, or equivalent preparation approved by the Head of the School of Physical and Chemical Sciences.

NOTE: Laboratory attendance is COMPULSORY. In order to be ELIGIBLE to pass CHEM112/BCHM112, you must pass the laboratory course and have satisfactory attendance at laboratory sessions.

The Laboratory Classes:

The CHEM/BCHM112 laboratory classes commence the **SECOND WEEK** of the semester (i.e. the week beginning 22nd July). You must assign yourself to a laboratory (via My Timetable); this is normally indicated on your fees receipt. If you cannot assign yourself to a laboratory class or if you **have a timetable clash** with the class you have been assigned, you should contact Justine Cottam (chemistry112@canterbury.ac.nz) during the first week of Semester 2.

The available sessions are:

Lab 01	Tuesday	13:00 – 15:50	Lab 02	Wednesday	9:00 – 11:50
Lab 03	Wednesday	13:00 – 15:50	Lab 04	Thursday	9:00 – 11:50
Lab 05	Thursday	15:00 – 17:50	Lab 06	Friday	12:00 – 14:50

The laboratory sessions are an essential part of CHEM112/BCHM112. All experiments are COMPULSORY and ASSESSABLE; you must satisfactorily complete all 6 experiments/labs to pass the course. For each experiment you will be supplied with a lab manual, an experiment information file and an experiment video to watch before your laboratory session. Prior to each lab you are required to read the experiment information file, watch the pre-lab video, and read and understand the introduction, theory, and experimental sections for that experiment in the lab manual. **For experiments 2-6 you are also required to complete online pre-laboratory questions which will be on the CHEM112/BCHM112 experiment laboratory pages on AKO | LEARN.** These pre-lab online quizzes are COMPULSORY, and each are worth part of your overall lab

mark for that experiment. The pre-laboratory quiz for the next experiment will open after the last lab session on Friday of the CHEM112/BCHM112 lab week.

The pre-laboratory quizzes will close at 5 PM on MONDAY of the CHEM112/BCHM112 lab week.

In each lab you will be required to complete a results sheet during the laboratory session and hand it in at the end to be marked. BEFORE your first laboratory session you will be required to complete an online safety quiz (this is marked and forms part of your overall grade). The laboratory experiments are worth 15% of your course mark. **All laboratory work is ASSESSED and examinable**.

Laboratory organization: Each laboratory is under the direct control of a senior supervisor, who will give an introductory lab talk at the start of each class, highlighting relevant details about the lab with emphasis on the safety important safety aspects of the lab experiment. Your work in the lab will be supervised and your weekly reports will be graded by one of the demonstrating team. If you encounter difficulties during the lab, you are free to consult any demonstrator, senior supervisor, or academic staff member.

Dress for the Laboratory:
Safety glasses: are not supplied. You must wear approved eye protection in the laboratory **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. They must be purchased before attending your first laboratory class.

Laboratory coats: must be worn, done up, at all times in the laboratory. Coats approved for use in all Science Faculty laboratories are available for purchase from the Department of Chemistry prior to your first laboratory class.

PURCHASING SAFETY GLASSES AND LABORATORY COATS

Safety glasses ($10) and laboratory coats ($37.50) These may be purchased on-line from the University at:

https://www.canterbury.ac.nz/science/current-students/shop/

Laboratory coats & glasses 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:

Thursday 11th July and Friday 12th July between the hours of 9.00 – 10.00am

First two weeks of Semester Two: 15th July to 19th July and 22nd July to 26th July, Mon - Fri between the hours of 8.30 – 9.30am or 12:30 – 1.30pm

Coats and glasses can be collected inside the southern entry to the Ernest Rutherford Building

From 29th July, pickup will be on Tuesday and Thursday, 1.30 – 2.00pm Ernest Rutherford, Chemistry Stores, 130A.

Note: covered shoes must be worn in the stores area.

Suitable footwear: must be worn at all times in the laboratory. For safety reasons this means footwear **that covers all of your feet**. No open-topped or open-toed or backless footwear and absolutely no Jandals.

Laboratory manuals: are provided. A coloured electronic copy is on the AKO | LEARN website and manuals will be available to collect outside Ernest Rutherford (ER 421) before the first laboratory.

Safety Quiz: This will be on the Learn site and MUST be completed BEFORE you come to **your first lab class (week 2).** More information will be given in lectures. This quiz is marked and counts towards your lab score.

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 contact the laboratory coordinator Dr Justine Cottam (chemistry112@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).

Absences due to illness: 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.

Unexcused absences: may constitute an unsatisfactory record and result in you failing the laboratory requirement and hence CHEM112/BCHM112. They will be assigned a mark of zero for that experiment and will degrade your final mark. If you miss a lab (or are going to miss a lab) you must contact Dr Justine Cottam. Under certain circumstances they can grant an exemption.

Exemption from the laboratory Course: 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. Students who wish to apply (and you must apply) for an exemption should contact Dr Chris Fitchett (Julius von Haast 626 or, preferably, e-mail chris.fitchett@canterbury.ac.nz by the end of the second week of the Semester.

Pre-lab questions: Prior to each experimental laboratory session, you are expected to read the experiment information file, watch the pre-lab video on LEARN (videos are on the CHEM112/BCHM112 LEARN laboratory pages) and read and understand the introduction, theory, and experimental sections for that experiment in the lab manual. **For each experiment (except the first one) you are also required to complete online pre-laboratory questions which will be on the CHEM112/BCHM112 experiment laboratory pages on LEARN**. These pre-laboratory quizzes are COMPULSORY and and each quiz is worth part of your overall lab mark for that given experiment. The pre-laboratory quiz for the next experiment will open after the last lab session on Friday of the CHEM112/BCHM112 lab week.

The pre-laboratory quizzes will close at 5 PM on MONDAY of the CHEM112/BCHM112 lab week.

Laboratory Assessment: During the course you will be expected to become proficient at common laboratory techniques such as distillation, heating under reflux, purification of products, accurately recording 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.

Each week you will be supplied with a report sheet for the week's experiment. This is completed during the lab and handed in to your demonstrator before leaving. Your demonstrator will grade it and return it to you at the next laboratory period. It is **strongly recommended** that you retain your report sheets after marking because: (a) they represent proof that you attended the Lab that week and; (b) more importantly perhaps, some test/exam questions are based on Laboratory experiments.

If your overall attendance at laboratories is judged unsatisfactory you will not be given a pass in the laboratory course and will thus fail CHEM112/BCHM112. 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, or required to complete the laboratories at a later date.

"BestChoice" On-line Problems and Quizzes

"BestChoice" is a computer-based service provided by the University of Auckland. All students enrolled in CHEM112-BCHM112 will be given free access to the BestChoice website. This contains a comprehensive selection of computer-based practice exercises ("problems") which cover nearly all aspects of the CHEM112-BCHM112 course material. You are expected to use this as complementary learning material and your participation in BestChoice is worth **10% of the marks** for CHEM112-BCHM112. To achieve this mark, you must complete a certain percentage of the activities available. You will be notified of this on the Learn site.

Details of how to log-in will be posted on Learn and will not start until Week 2

Computer equipment: The University provides several student computer facilities. All available computer facilities can be found at: http://www.canterbury.ac.nz/its/computer-workrooms/

CHEM/BCHM112 course content outline:

STRUCTURE, ISOMERISM, STEREOCHEMISTRY AND SYNTHESIS

Weeks 1-3, taught by Jodie Johnston

- Representations of organic molecules
- Functional groups
- Resonance
- Types of Isomerism
- Stereochemical descriptors
- Optical rotation
- Stereochemistry in amino acids and introduction to peptides
- Stereochemistry in carbohydrates
- Molecular characterisation using Mass spectrometry and NMR

REACTION MECHANISMS

Weeks 4-7, taught by Chris Fitchett

- Types of Organic Reactions
- Introduction to reaction mechanisms and using mechanistic arrows
- Conventions used for drawing mechanisms
- Introduction to nucleophilic addition and substitution
- Nucleophilic substitutions of alkyl halides
- Electrophilic additions to alkenes
- Electrophilic substitutions of benzene

TRANSITION METAL CHEMISTRY

Weeks 8-12, taught by Paul Kruger

- Electron configurations and oxidation states
- Redox reactions and analyses
- Complexation, equilibria, and the chelate effect
- Ligand exchange mechanisms
- Complexes in medicine and biology
- Isomerism
- Colour and crystal field theory
- Electrochemical cells, reduction potentials, and the Nernst equation

CHEM/BCHM112 Learning Objectives

Structure, Isomerism, Stereochemistry and Synthesis

Weeks 1-3, taught by Jodie Johnston

At the end of this section you should be able to:

- Describe and demonstrate the conventions used for representing organic molecules
- Recognise common functional groups
- Interpret the conventional (IUPAC) nomenclature used for the naming of simple organic molecules
- Describe the concept of resonance, recognise situations where it may occur, and provide examples of it.
- Define and provide examples of the distinction between the terms: structural (constitutional) isomerism and stereoisomerism, conformational and configurational isomerism, enantiomers and diastereoisomers
- Be able to assign: R/S descriptors to enantiomers and E/Z descriptors to alkenes
- Describe and illustrate the isomerism in substituted cycloalkanes
- Define and explain the terms: optical rotation, polarimeter, racemic mixture, meso compound
- Provide examples of the importance of chirality in nature
- Outline the structural and stereochemical features of simple carbohydrates, amino acids and peptides
- Describe how molecules can be characterised using NMR and Mass spectrometry

Reaction Mechanisms

Weeks 4-7, taught by Chris Fitchett

At the end of this section you should be able to:

- Understand what is meant by a reaction mechanism, and differentiate different types of reaction.
- Identify the Nucleophile and Electrophile in chemical reactions.
- Analyse a substitution reaction to determine which type of mechanism are operating.
- Use Curly Arrows to illustrate a mechanism, and predict the structure of any intermediates and transition states.
- Evaluate how changes in reactant structure, leaving group ability and nucleophile can affect the reaction mechanism and energy profile
- Use Curly Arrows to show the mechanism for the electrophilic addition to alkenes of Br_2, HBr/HCl and H_2O and the origin of Markovnikov's rule.

- Evaluate the mechanism of addition reactions of alkenes using structural features of the reactants, and predict the structure of any intermediates and transition states.
- Recognise the different types of carbonyl groups, and predict the outcome of their nucleophilic substitution and addition reactions.
- Understand the reactivity of Grignard reagents and predict the outcome of their reactions with electrophiles (water, carbonyl groups, epoxides, etc).
- Evaluate the mechanism of electrophilic substitution reactions of benzene (halogenation, nitration, alkylation and acylation) using Curly Arrows, and predict the structure of any intermediates and transition states.
- Use the synthetic transformations discussed as part of short reactions schemes (2-4 steps).

TRANSITION METAL CHEMISTRY

Weeks 8-12, taught by Paul Kruger

At the end of this section you should be able to:

- define transition metals in terms of their electron configurations, describe complex formation in solution, define and give examples of the terms: co-ordination compound (complex or complex ion), co-ordination number, ligand, denticity, and chelate;
- identify common oxidation states of the first row transition metals, and give examples of their use in quantitative redox titrations;
- explain and give examples of the use of coloured compounds in qualitative and quantitative analysis;
- write equilibrium expressions to describe the stability of complexes, describe complex formation in solution by stepwise substitution reactions, explain the chelate effect, describe the meaning of the terms labile and inert in this context and outline common mechanisms of substitution;
- give examples of isomerism and optical activity in transition metal complexes and be able to recognise cases where they may exist;
- describe the chemistry involved in complexometric titrations, chelation therapy, and cancer treatment using cisplatin (*cis*-diamminedichloridoplatinum(II)).
- give examples of the roles of transition metals in biology;
- use Crystal Field Theory (CFT) to account for some of the observed physical properties of transition metal complexes (colour and magnetism);
- account for the forms in which transition metals are found in nature in terms of Hard-Soft Acid-Base (HSAB) theory and describe how trends in standard electrode potentials for the reduction of M^{2+} and M^{3+} affect the choice of method for the industrial production of the metal;
- describe the different kinds of electrochemical measurements that can be made, explain the connection between redox reactions and electrochemistry, define the terms emf and standard reduction potential, and use them to deduce the relative oxidizing or reducing power of a redox system;
- to write down the conventional cell diagram for an electrochemical cell, based either on a given spontaneous redox reaction or on experimental data for a given cell, and vice versa;
- explain how the experimental reversible electric potential difference (reversible emf), E_{cell}, between a pair of electrodes in a cell is related to the free energy change of the cell reaction under any conditions by $\Delta G = -nFE_{cell}$
  and under standard conditions by $\Delta G^\circ = -nFE^\circ_{cell}$

- to use the Nernst equation to calculate the emf of a cell under non-standard conditionsand to calculate the emf of a concentration cell.

GENERAL INFORMATION | TE KIMI MŌHIOHIO 2024

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. Note that the use of **AI generative tools such as ChatGPT** for assessment work is *strictly forbidden*, except where the lecturer concerned has specifically granted approval.
- ***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.

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
2024