UNSW Course Outline

CHEM2031 Inorganic Chemistry: The Elements - 2024

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General Course Information

Course Code : CHEM2031
Year : 2024
Term : Term 3
Teaching Period : T3
Is a multi-term course? : No
Faculty : Faculty of Science
Academic Unit : School of Chemistry
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : Kensington
Campus : Sydney
Study Level : Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

The periodic table gives us the elements to imagine an infinite number of compounds, but a relatively tiny number can be made. Why is it that some compounds exist, and others do not? Why is carbon monoxide so much more toxic than carbon dioxide despite being just one atom

different? And although carbon dioxide is a leading cause of global warming, can other inorganic compounds help establish a greener climate future? This course will give students a deep insight into the building blocks of chemistry. Students will learn answers to the questions posed above, and will also see the pivotal role of inorganic chemistry in human health and industrial processes. The knowledge from this course will underpin what students might learn in future chemistry, biology, medicine, and physics courses.

Welcome to CHEM2031 — Inorganic Chemistry: The Elements! Whilst the field of organic chemistry is concerned with the chemistry of carbon, in this course we explore much more of the periodic table. This course combines a program of lectures from leading academics with an engaging, hands-on and individual lab program where students get the opportunity to make colourful inorganic complexes and study their properties. The course starts by teaching students the principles of bonding in chemistry. and builds to teach the structures and properties of metal complexes. Students will see how changing the molecular framework around a metal ion can modulate the properties of the resulting complex. Finally, students will learn how inorganic and organometallic complexes are important to (or toxic to!) the body, and their roles in industry and the environment.

Course Aims

The aim of this course is to provide students with the opportunity to develop their understanding of key topics in inorganic chemistry such as quantum theory, and the electronic and geometric structures of atoms and molecules. These topics will be built upon through study of solid-state chemistry, transition-metal chemistry, and organometallic chemistry. The relevance of this chemistry to the real world will be highlighted with industrial and medical links. The theoretical part of the course will be reinforced and extended by a laboratory course, which will also teach laboratory skills and develop safe competency.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Apply molecular orbital and valence bond theory to predict and rationalise the structures and properties of small molecules, and compare and contrast these models of bonding.
CLO2 : Explain and predict the colour, magnetism, structure, and reactivity of first-row transition metal complexes using ligand-field theory.
CLO3 : Describe the molecular basis of organometallic chemistry and use this to explain the key steps in industrially-relevant catalytic cycles and biological systems.
CLO4 : Execute lab procedures safely to prepare inorganic metal complexes, analyse their properties, and critically discuss the results in written reports.

Course Learning Outcomes	Assessment Item
CLO1 : Apply molecular orbital and valence bond theory to predict and rationalise the structures and properties of small molecules, and compare and contrast these models of bonding.	• Assignments • Mid-term Test • Laboratory Work
CLO2 : Explain and predict the colour, magnetism, structure, and reactivity of first-row transition metal complexes using ligand-field theory.	• Examination • Assignments • Laboratory Work
CLO3 : Describe the molecular basis of organometallic chemistry and use this to explain the key steps in industrially-relevant catalytic cycles and biological systems.	• Examination • Assignments • Laboratory Work
CLO4 : Execute lab procedures safely to prepare inorganic metal complexes, analyse their properties, and critically discuss the results in written reports.	• Laboratory Work

Learning and Teaching Technologies

Moodle - Learning Management System

Learning and Teaching in this course

Practice: Engaging An integrated lecture and practical course enables:

(i) Effective learning, wherein students are actively engaged in the learning process, and

(ii) are supported by a climate of inquiry where students are appropriately challenged and activities are linked to research and scholarship.

Strategy: Contextualise

(iii) Students become more engaged in the learning process if they can see the relevance of their studies to professional, disciplinary and/or personal contexts.

Strategy: Design

(iv) Clearly articulated expectations, goals, learning outcomes, and course requirements increase student motivation and improve learning.

(v) The qualities and skills the university hopes its students will develop as a result of their

university studies (Graduate Capabilities) are most effectively acquired in a disciplinary context.

Strategy: Teaching

(vi) Learning cooperatively with peers rather than individually or competitively may help students to develop interpersonal, professional, and cognitive skills to a higher level.

Teaching is by a combination of lectures (both asynchronous (i.e. pre-recorded) and live, 4 h / wk), online resources, and laboratory classes. We encourage students to ask questions about the broader course content to the academics and demonstrators in their lab classes.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Examination Assessment Format: Individual	40%	
Assignments Assessment Format: Individual	9%	
Mid-term Test Assessment Format: Individual	21%	
Laboratory Work Assessment Format: Individual	30%	

Assessment Details

Examination

Assessment Overview

The final exam is designed to test your understanding of the content delivered by the 2nd and 3rd lecturers in the course (note that the mid-term test covers the content from the first lecturer) through lectures, tutorials, and digital materials. The exam contains questions which require short answers, paragraphs, drawings, or numerical responses. The exam lasts 2 hours and takes place during the formal examination period. Final details will be confirmed during the teaching term. Feedback is available through enquiry with the course convenor.

Hurdle requirement: You must achieve an overall weighted average grade of at least 35% in the final exam and the mid-term test combined to pass the course.

Course Learning Outcomes

- CLO2 : Explain and predict the colour, magnetism, structure, and reactivity of first-row

transition metal complexes using ligand-field theory.
- CLO3 : Describe the molecular basis of organometallic chemistry and use this to explain the key steps in industrially-relevant catalytic cycles and biological systems.

Hurdle rules

You must achieve an overall weighted average grade of at least 35% in the final exam and the mid-term test combined to pass the course

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.
For more information on Generative AI and permitted use please see here.

Assignments

Assessment Overview

You will complete three take-home assignments related to the course lecture content. These assignments will take the form of either a quiz, or a structured independent research study. These assignments are designed to support your understanding of the lecture course, and to give you the opportunity to obtain feedback ahead of the mid-term test and the exam (see below). Each assignment contributes 3% of the course grade, and you will have 1-2 weeks to complete each. Feedback will typically be provided within 2 weeks of submission.

Hurdle requirement: You are required to attain an overall (weighted average) score of at least 50% in the continuous-assessment portion of the course (i.e. the lab class, and the assignments) to pass the course.

Course Learning Outcomes

- CLO1 : Apply molecular orbital and valence bond theory to predict and rationalise the structures and properties of small molecules, and compare and contrast these models of bonding.
- CLO2 : Explain and predict the colour, magnetism, structure, and reactivity of first-row transition metal complexes using ligand-field theory.
- CLO3 : Describe the molecular basis of organometallic chemistry and use this to explain the key steps in industrially-relevant catalytic cycles and biological systems.

Hurdle rules

You are required to attain an overall (weighted average) score of at least 50% in the continuous-

assessment portion of the course (i.e. the lab class, and the assignments) to pass the course.

Generative AI Permission Level

Simple Editing Assistance

In completing this assessment, you are permitted to use standard editing and referencing functions in the software you use to complete your assessment. These functions are described below. You must not use any functions that generate or paraphrase passages of text or other media, whether based on your own work or not.
If your Convenor has concerns that your submission contains passages of AI-generated text or media, you may be asked to account for your work. If you are unable to satisfactorily demonstrate your understanding of your submission you may be referred to UNSW Conduct & Integrity Office for investigation for academic misconduct and possible penalties.
For more information on Generative AI and permitted use please see here.

Simple grammar and spellchecking only e.g. as found in Microsoft Word.

Mid-term Test

Assessment Overview

You will be expected to complete a mid-term test which relates to content from the first lecturer's lectures, tutorials, and digital content (CLO1). The test is designed to assess your understanding of the course content. The test typically takes place in week 5 or 7, and takes approximately 45 minutes. The test typically contains questions which require short answers, paragraphs, drawings, or numerical responses. Marks will be released through Moodle and feedback is available by consultation with the lecturer responsible.

Hurdle requirement: You must achieve an overall weighted average grade of at least 35% in the final exam and the mid-term test combined to pass the course.

Course Learning Outcomes

- CLO1 : Apply molecular orbital and valence bond theory to predict and rationalise the structures and properties of small molecules, and compare and contrast these models of bonding.

Hurdle rules

You must achieve an overall weighted average grade of at least 35% in the final exam and the mid-term test combined to pass the course.

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Laboratory Work

Assessment Overview

You will complete a laboratory class most weeks during the entire teaching period. The laboratory-related assessments are designed to develop your ability to communicate scientific results, to work safely, and to guide your understanding of the lab content and/or analysis.

Typically, before each lab you will complete short pre-lab activities, such as a quiz, or preparing your lab notebook. During the laboratory classes you will typically record your activities and observations in a laboratory notebook, for which you will be given regular feedback. After the lab class, you will typically complete a written lab report, through which you will learn to communicate scientific procedures at a professional standard.

You will also be assessed relative to various core skills, which are hurdle tasks, typically including: securing a minimum mark in your lab book; securing a minimum mark on your lab procedures; working safely; maintaining clean glassware; meeting the attendance requirement (at most this comprises an induction in week 1, plus 8 lab classes in weeks 2-5 and 7-10, but the final details will be released in week 0 of term). Lab reports are typically due 1-2 weeks after the lab class, and feedback from earlier labs (after the first lab) is typically available prior to the deadline.

Labs run over one or two weeks. The grade for each lab class is weighted according to the complexity of the lab, and additional marks are available for achieving the core skills.

The lab assessments are designed to provide you with the opportunity for very regular feedback on your work. Feedback is provided by 1:1 interaction with demonstrators in the lab, digital markup on submitted work, and written or verbal feedback on lab notebooks.

Hurdle requirements: In addition to the lab requirements detailed above, you are required to attain an overall (weighted average) score of at least 50% in the continuous-assessment portion

of the course (i.e. the lab class, and the assignments) to pass the course.

Course Learning Outcomes

- CLO1 : Apply molecular orbital and valence bond theory to predict and rationalise the structures and properties of small molecules, and compare and contrast these models of bonding.
- CLO2 : Explain and predict the colour, magnetism, structure, and reactivity of first-row transition metal complexes using ligand-field theory.
- CLO3 : Describe the molecular basis of organometallic chemistry and use this to explain the key steps in industrially-relevant catalytic cycles and biological systems.
- CLO4 : Execute lab procedures safely to prepare inorganic metal complexes, analyse their properties, and critically discuss the results in written reports.

Assessment information

Assessment criteria and standards

Attendance: Unless a specific exemption is granted by the School, students must attempt all lab experiments in the laboratory component before being considered for a pass in the course (see UNSW Policy https://my.unsw.edu.au/student/atoz/AttendanceAbsence.html). A laboratory exemption may be available for repeating students who performed satisfactorily in the lab component of CHEM2031 in a recent past year (see the "Lab Exemption" page on Moodle for details, read below, or contact the course coordinator).

Laboratory Work: Pre-laboratory work is expected to take an average of 15-30 minutes per week (including safety matters). Post-laboratory write-ups and quizzes are expected to take an average of 60-90 minutes per week.

Hurdle rules

In addition to the lab requirements detailed above, you are required to attain an overall (weighted average) score of at least 50% in the continuous-assessment portion of the course (i.e. the lab class, and the assignments) to pass the course.

Generative AI Permission Level

Simple Editing Assistance

In completing this assessment, you are permitted to use standard editing and referencing functions in the software you use to complete your assessment. These functions are described below. You must not use any functions that generate or paraphrase passages of text or other media, whether based on your own work or not.
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media, you may be asked to account for your work. If you are unable to satisfactorily demonstrate your understanding of your submission you may be referred to UNSW Conduct & Integrity Office for investigation for academic misconduct and possible penalties.
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Simple grammar and spellchecking, e.g. those functions found in Microsoft Word

General Assessment Information

Feedback for assessment items will be given within two weeks of submission.

Laboratory assessment: laboratory assessment tasks comprise a mixture of short quizzes (pre-labs and post-labs), written reports, and maintenance of a satisfactory lab book. Full details will be given in week 1. There is a compulsary lab induction in week 1 and the full lab course starts in week 2.

Laboratory attendance: attendance will be recorded for each lab class.

Illness or activity affecting ability to complete labs: if you are unwell or have another allowable excuse which affects your ability to complete a lab during its timetabled weeks, you should apply for Special Consideration. If your request is granted by the central unit then we will offer either an adjusted deadline for report submission, or will provide a representative grade based on your performance in other lab activities. Make-up labs will not typically be offered.

Further information:

UNSW grading system: https://student.unsw.edu.au/grades

UNSW assessment policy: https://student.unsw.edu.au/assessment

Grading Basis

Standard

Requirements to pass course

Important note: To be awarded a pass in this subject, along with achieving a cumulative score of ≥ 50%, students must satisfy two conditions:

(i) A mark of ≥ 50% in the continuous assessment component (laboratory reports and assignments), **and gain all core laboratory skills**

(ii) Satisfactory overall performance (≥ 35%) in the examination components (the weighted marks from the mid-term and final examinations).

Failure to satisfy either criterion will result in a FL or UF (Unsatisfactory Fail) grade being awarded, or further assessment being offered at the discretion of the course coordinator. Students must ensure their availability to attend any supplementary examination that will usually be offered in the week suggested by UNSW; inability or failure to attend a supplementary examination may lead to a FL or UF (Unsatisfactory Fail) grade being confirmed.

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 9 September - 15 September	Lecture	Topic A - Dr Sulway (4h, of which 2 hours pre-recorded (online mini lectures) and 2 hours in-person (Wed 14:00 - 16:00, Tyree Energy Technology G16 (K-H6-G16))
	Laboratory	Lab induction (Attendance is compulsory.)
Week 2 : 16 September - 22 September	Lecture	Topic A - Dr Sulway (4h, of which 2 hours pre-recorded (online mini lectures) and 2 hours in-person (Wed 14:00 - 16:00)
	Laboratory	Iron experiment
	Assessment	Assignment for Section A released on Moodle
Week 3 : 23 September - 29 September	Lecture	Topic A - Dr Sulway (4h, of which 2 hours pre-recorded (online mini lectures) and 2 hours in-person (Wed 14:00 - 16:00)
	Laboratory	Cobalt experiment
	Assessment	Reports due online for iron
Week 4 : 30 September - 6 October	Lecture	Topic B - Prof Sharma (4h), of which 2 hours pre-recorded (online mini lectures) and 2 hours in-person (Wed 14:00 - 16:00)
	Laboratory	Copper experiment (synthesis)
	Assessment	• Reports due online for Cobalt • Assignment for Section A due
Week 5 : 7 October - 13 October	Lecture	Topic B - Prof Sharma (4h), of which 2 hours pre-recorded (online mini lectures) and 2 hours in-person (Wed 14:00 - 16:00)
	Laboratory	Copper experiment
	Assessment	• Assignment for Section B released on Moodle • Mid-term exam
Week 6 : 14 October - 20 October	Other	Flexibility week - no classes
Week 7 : 21 October - 27 October	Lecture	Topic B - Prof Sharma (4h), of which 2 hours pre-recorded (online mini lectures) and 2 hours in-person (Wed 14:00 - 16:00)
	Laboratory	Vanadium experiment
	Assessment	Reports due online for copper
Week 8 : 28 October - 3 November	Lecture	Topic C - A/Prof Graham Ball (4h), of which 2 hours pre-recorded (online mini lectures) and 2 hours in-person (Wed 14:00 - 16:00)
	Laboratory	Conductivity/Magnetic moments
	Assessment	• Reports due online for vanadium experiment • Assignment for Section B due • Assignment for Section C released on Moodle
Week 9 : 4 November - 10 November	Lecture	Topic C - A/Prof Graham Ball (4h), of which 2 hours pre-recorded (online mini lectures) and 2 hours in-person (Wed 14:00 - 16:00)
	Laboratory	Ferrocene
	Assessment	• Reports due online for experiment conductivity/magnetic moments
Week 10 : 11 November - 17 November	Lecture	Topic C - A/Prof Graham Ball (4h), of which 2 hours pre-recorded (online mini lectures) and 2 hours in-person (Wed 14:00 - 16:00)
	Laboratory	Ferrocene
	Assessment	• Reports due online for ferrocene • Assignment for Section C due

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

General Schedule Information

This course comprises up to 6-8 hours per week of class contact hours. You are expected to take at least an additional 6-8 hours of non-class contact hours to complete assessments, readings and for exam preparation.

In Section A (12h lectures and pre-recorded videos), the course covers the electronic structure of atoms based on the quantum mechanical model, with extension to simple molecules and bonding models. An introduction to the general chemistry of the trends and patterns in the periodic table will be given. The lectures for this part are given by Dr Sulway.

In Section B (12h lectures and pre-recorded videos), transition metal chemistry is introduced, leading to an understanding of coordination chemistry and the properties of transition metal complexes with a d1-d9 electron configuration. This includes colour, magnetism and stability. A brief introduction to the chemistry of the f-block will also be included. The lectures for this part are given by Prof Sharma.

In Section C (12h lectures and pre-recorded videos) the basics of organometallic chemistry and bioinorganic chemistry will be covered. This will include the structure of organometallic complexes, the 18-electron rule, sigma and pi bonding and the synthetic routes to organometallic complexes. An overview of the roles of metals in biology will be covered, including the methods nature uses to store, transport and manage metal ions, and the roles of metals in metalloenzymes and medicine. The lectures for this part are given by A/Prof Ball.

NOTE: the schedule below is not necessarily complete with respect to assessments. You mustrefer to Moodle (assessment hub) for up-to-date assessment details.

Course Resources

Prescribed Resources

Housecroft and Sharpe: Inorganic Chemistry, 5th Edition, 2018 (earlier editions also useful)

Publisher: Pearson Education Limited, Harlow, UK

Format: Paperback

ISBN: 9781292134147

e-book version available for free via UNSW Library, at time of writing. Link available on Moodle page.

Recommended Resources

Students may find the following books useful. However, students are not required (or expected) to purchase any of these books.

Silberberg, Chemistry (McGraw Hill, 4th edition, 2006)

Cotton, Wilkinson and Gaus, Basic Inorganic Chemistry (Wiley, 3rd edition, 1995).

Shriver and Atkins, Inorganic Chemistry (Oxford, 5th edition, 2010)

Weller, Overton, Rourke, Armstrong, Inorganic Chemistry (Oxford, 7th edition, 2018)

Others will be advised by individual lecturers. Students do not need to purchase these books.

Additional Costs

Students must have the following materials for the laboratory class:

- Lab coat
- Safety glasses
- Closed shoes
- An A4 lined notebook, at least 48 pages, to use as a lab notebook. This notebook should be dedicated to CHEM2031 and not used for other courses/notes, so that it can be submitted for marking if necessary.

Course Evaluation and Development

We use the myExperience survey and details are available on Moodle. Course representatives will be appointed early in term. Feedback is always welcome to the course coordinator and will be considered carefully.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Graham Ball				By appointment	Yes	Yes
Lecturer	Neeraj Sharma				By appointment	No	No
	Scott Sulway				By appointment	No	No

Other Useful Information

Academic Information

Upon your enrolment at UNSW, you share responsibility with us for maintaining a safe, harmonious and tolerant University environment.

You are required to:

- Comply with the University's conditions of enrolment.
- Act responsibly, ethically, safely and with integrity.
- Observe standards of equity and respect in dealing with every member of the UNSW community.
- Engage in lawful behaviour.
- Use and care for University resources in a responsible and appropriate manner.
- Maintain the University's reputation and good standing.

For more information, visit the UNSW Student Code of Conduct Website.

Academic Honesty and Plagarism

Referencing is a way of acknowledging the sources of information that you use to research your assignments. You need to provide a reference whenever you draw on someone else's words, ideas or research. Not referencing other people's work can constitute plagiarism.
Further information about referencing styles can be located at https://student.unsw.edu.au/referencing

Academic integrity is fundamental to success at university. Academic integrity can be defined as a commitment to six fundamental values in academic pursuits: honesty, trust, fairness, respect, responsibility and courage. At UNSW, this means that your work must be your own, and others' ideas should be appropriately acknowledged. If you don't follow these rules, plagiarism may be

detected in your work.

Further information about academic integrity, plagiarism and the use of AI in assessments can be located at:

- The Current Students site,
- The ELISE training site, and
- The Use of AI for assessments site.

The Student Conduct and Integrity Unit provides further resources to assist you to understand your conduct obligations as a student: https://student.unsw.edu.au/conduct

Submission of Assessment Tasks

Penalty for Late Submissions

UNSW has a standard late submission penalty of:

- 5% per day,
- for all assessments where a penalty applies,
- capped at five days (120 hours) from the assessment deadline, after which a student cannot submit an assessment, and
- no permitted variation.

Any variations to the above will be explicitly stated in the Course Outline for a given course or assessment task.

Students are expected to manage their time to meet deadlines and to request extensions as early as possible before the deadline.

Special Consideration

If circumstances prevent you from attending/completing an assessment task, you must officially apply for special consideration, usually within 3 days of the sitting date/due date. You can apply by logging onto myUNSW and following the link in the My Student Profile Tab. Medical documentation or other documentation explaining your absence must be submitted with your application. Once your application has been assessed, you will be contacted via your student email address to be advised of the official outcome and any actions that need to be taken from there. For more information about special consideration, please visit: https://student.unsw.edu.au/special-consideration

Important note: UNSW has a "fit to sit/submit" rule, which means that if you sit an exam or submit a piece of assessment, you are declaring yourself fit to do so and cannot later apply for

Special Consideration. This is to ensure that if you feel unwell or are faced with significant circumstances beyond your control that affect your ability to study, you do not sit an examination or submit an assessment that does not reflect your best performance. Instead, you should apply for Special Consideration as soon as you realise you are not well enough or are otherwise unable to sit or submit an assessment.

Faculty-specific Information

Additional support for students

- The Current Students Gateway
- Student Support
- Academic Skills and Support
- Student Wellbeing, Health and Safety
- Equitable Learning Services
- UNSW IT Service Centre
- Science EDI Student Initiatives, Offerings and Guidelines

School-specific Information

UNSW Changes to Special Consideration: Short Extension

The School of Chemistry has carefully reviewed all of its assessments to determine whether they are suitable for automatic short extensions as set out by the UNSW Short Extension Policy. The current deadline structures for all assessment tasks in the School of Chemistry already accommodate the possibility of unexpected circumstances that may lead students to require additional time for submission. **The School of Chemistry has opted out of the UNSW Short Extension provision for all its courses,** and we have already integrated flexibility into our assessment deadlines. This decision is subject to revision in response to the introduction of new course offerings. All students may still apply for Special Consideration for any assessment via the usual procedures.

School Contact Information

Level 1, Dalton Building (F12)

W: www.chemistry.unsw.edu.au

Also see: ***Contacts and Support*** section of the course Moodle page (where applicable)