Course Outline

CHEM2031

INORGANIC CHEMISTRY: THE ELEMENTS

School of Chemistry

Faculty of Science

Term 3, 2021

Pre-course preview version, 1st July 2021

An updated version of this document (including final timetabling; staff; extra lab details) will be released in Week 0 of T3. You must check the final version of the outline for essential information.

If you have queries before then, please contact the Course Coordinator.

1. **Staff**

Position	Name	Email	Consultation times and locations	Contact Details
Course Convenor and Lecturer	Dr Martin Peeks	m.peeks@unsw.edu.au	By appointment	Room 219 Dalton Building (F12) or remotely; ext. 57375
Lecturer	A/Prof Neeraj Sharma	neeraj.sharma@unsw.edu.au	By appointment	Room 129 Dalton Building (F12) or remotely
Lecturer	A/Prof Graham Ball	g.ball@unsw.edu.au	By appointment	Room 224 Dalton Building (F12) or remotely
Academic Laboratory Supervisor	A/Prof John Stride	j.stride@unsw.edu.au	By appointment	Room 131 Dalton Building (F12) or remotely
Academic Laboratory Supervisor	Dr Dong Jun Kim	dongjun.kim@unsw.edu.au	By appointment	Room 718 SEB (E8) or remotely

2. Course information

Term offered: T3

Units of credit: 6

Pre-requisite(s): (CHEM1011 or CHEM1031), and (CHEM1021 or CHEM1041), and CHEM2041

Teaching times and locations: http://timetable.unsw.edu.au/2021/CHEM2031.html

Component	Day	Time	Location
Lecture 1	Monday	4 pm – 5pm	Online
Lectures 2 and 3	Thursday	11 am – 1 pm	Online
Lecture 4	Friday	11 am – 12 noon	Online
Laboratory class 1	Tuesday	9 am – 1 pm	Lab 262, F10 Chemical Sciences Building
Laboratory class 2	Tuesday	2 pm – 6 pm	Lab 262, F10 Chemical Sciences Building

Laboratory class 3	Wednesday	9 am – 1 pm	Lab 262, F10 Chemical Sciences Building
Laboratory class 4	Wednesday	2 pm – 6 pm	Lab 262, F10 Chemical Sciences Building

Special details:

- All lecture materials will be delivered online through Blackboard Collaborate Ultra or the CHEM2031 Moodle page.
- The in-person laboratory component will take place in Lab 262, F10 ChemSci. The lab manual will be available from Moodle. For students affected by COVID-19 and unable to attend in-person for the entire course (i.e. stuck overseas), an alternative online lab class will be offered.
- The first fifteen minutes of each laboratory class comprises a compulsory safety briefing and pre-lab sign-off. Students must arrive promptly to their allocated laboratory class. Late arrivals may not be admitted.

Note: students attend one laboratory class per week.

2.1 Course summary

CHEM2031: This course provides a general introduction to both theoretical and practical aspects of advanced inorganic chemistry. The principles of quantum theory and symmetry are explained and then explored to account for the electronic and geometric structure of atoms and molecules. These concepts are then expanded further to include the study of such diverse areas as transition metals, organometallic chemistry and bioinorganic chemistry. The relevance of much of this chemistry to the world around us is highlighted with real examples of inorganic chemistry in action.

2.2 Course aims

Aims highlight the teacher's intentions for the course. They provide an overall big-picture vision of why this course is important for student learning. Relate aims to the alignment of the curriculum: resources, learning activities and assessment of the course components.

This course aims to teach you the essential theoretical and practical chemistry of inorganic compounds. You learn about the essential roles and fascinating chemistry of elements from across the periodic table, supported with a strong understanding of how electronic structure dictates properties. The course builds on material covered in Chemistry I, and it is students' responsibility to ensure they are familiar with that content.

The laboratory course gives you hands-on experience of the preparation and characterisation of metal complexes. You develop practical lab skills from reaction setup to crystallisation. You also use a range of characterisation techniques to interrogate the properties of metal complexes. You will also practice proper record-keeping and will develop an enhanced awareness of Laboratory Safety.

2.3 Course learning outcomes (CLO)

At the successful completion of this course you (the student) should be able to:

1. Apply principles of molecular orbital and valence bond theory to predict and rationalise the properties of small molecules, including their stability and magnetism. Develop an understanding of the strengths and weaknesses of different bonding models.
2. Understand how the arrangement of ligands around a transition metal ion affects its electronic structure and apply ligand-field theory to predict properties of simple octahedral and tetrahedral first-row transition metal complexes, including colour and magnetism.
3. Describe the molecular basis of organometallic chemistry and use it to rationalise key steps in industrially-relevant catalytic cycles & biological systems.
4. Synthesise inorganic metal complexes and analyse their properties by safely following lab procedures and using spectroscopic techniques, and prepare succinct and accurate laboratory reports.

2.4 Relationship between course and program learning outcomes and assessments

Course Learning Outcome (CLO)	Program Learning Outcome (PLO) – Chemistry Threshold Learning Outcomes	Related Tasks & Assessment
CLO 1	1.1, 2.1, 3.1, 3.3, 4.1, 5.1	Lectures, assignment, mid-term
CLO 2	1.1, 2.1, 2.2, 3.1, 3.2, 3.3	Lectures, assignment, final exam
CLO 3	1.1, 1.2, 1.3, 2.1, 2.2, 3.1	Lectures, assignment, final exam
CLO 4	1.1, 2, 3, 4, 5	Laboratory classes and related assessment

3. Strategies and approaches to learning

3.1 Learning and teaching activities

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 (4 h / wk), online resources, and practical laboratory classes. We encourage students to ask questions about the broader course content to the academics and demonstrators in their lab classes.

3.2 Expectations of students

Level of engagement: 4 h/wk of lecture; 4 h/wk of lab attendance; approx. 4 h/wk of non-contact study hours typically devoted to assignments, lab reports/pre-labs, and exam preparation.

Attendance: attendance at laboratory classes is compulsory; students are highly-encouraged to attend lectures “live”

Behaviour: behaviour both online and in person must be consistent with the UNSW Code of Conduct.

Email contact: students should expect that emails to lecturers will be responded to within two working days, during working hours.

4. Course schedule and structure

This course comprises of 8 hours per week of class contact hours. You are expected to take an additional 4 hours of non-class contact hours to complete assessments, readings and for exam preparation.

In Section A (6 x 2h lectures), 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 Peeks.

In Section B (6 x 2h lectures), 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 A/Prof Sharma.

In Section C (5 x 2h lectures) 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.

Week	Topic	Practical/Lab class	Lab reports due	Assignments	Related CLO
Week 1	Topic A Dr Martin Peeks (4h)	Lab induction in-person			1, 4
Week 2	Topic A Dr Martin Peeks (4h)	Laboratory experiment as rostered in lab manual		Assignment for Section A released on Moodle	1, 4
Week 3	Topic A Dr Martin Peeks (4h)	Laboratory experiment as rostered in lab manual	Reports due online for experiment 1		1, 4
Week 4	Topic B A/Prof Neeraj Sharma (4h)	Laboratory experiment as rostered in lab manual		**Assignment for Section A due**	2, 4
Week 5	Topic B A/Prof Neeraj Sharma (4h)	Laboratory experiment as rostered in lab manual	Reports due online for experiment 2	Assignment for Section B released on Moodle	2, 4

Week 6	Flexibility week				
Week 7	Topic B A/Prof Neeraj Sharma (4h)	Laboratory experiment as rostered in lab manual		**Mid-term exam – in a regular lecture slot, date tbc.**	2, 4
Week 8	Topic C A/Prof Graham Ball (4h)	Laboratory experiment as rostered in lab manual	Reports due online for experiment 3	**Assignment for Section B due** Assignment for Section C released on Moodle	3, 4
Week 9	Topic C A/Prof Graham Ball (4h)	Laboratory experiment as rostered in lab manual	Reports due online for experiment 4		3, 4
Week 10	Topic C A/Prof Graham Ball (4h)	Laboratory experiment as rostered in lab manual	Reports due online for experiment 5	**Assignment for Section C due**	3, 4

5. Assessment

5.1 Assessment tasks

Assessment task	Assessment criteria	Mark (% of total course grade)	Feedback	
			WHO	HOW
Assignment 1 (Quiz; Topic A)	Correct answers to questions	3	Dr Peeks	Grade and discussion
Assignment 2 (Quiz; Topic B)	Ditto	3	A/Prof Sharma	Marks and written feedback
Assignment 3 (Quiz; Topic B)	Ditto	3	A/Prof Ball	Marks and written feedback
Mid-term exam (Topic A)	Ditto	21	Dr Peeks	Marks and written feedback
Final exam (Topics B and C)	Ditto	40	N/A	
Laboratory reports and skills	See lab manual for full details	30	Practical class demonstrators	Marks and annotated report

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 both criteria will result in an UF (Unsatisfactory Fail) grade being awarded, or further assessment being offered at the discretion of the course coordinator. Inability or failure to attend a supplementary examination will result in the original grade being confirmed.

Feedback for assessment items will be given within two weeks of submission. For lab-related assessment items, feedback will be given within one week.

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. Marks may also be associated with the demonstration of particular “laboratory skills”.

Further information

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

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

5.2 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).

Attendance at Laboratory Classes is compulsory for CHEM2021 students and a roll is kept: The reasons for any absences should be conveyed to the Laboratory Supervisor. If these were due to health problems, they should be documented with a medical certificate. In such genuine instances no additional laboratory time will be allowed, but the laboratory marks obtained during session may be scaled accordingly so that you are not disadvantaged. A laboratory exemption may be available for repeating students who performed satisfactorily in the lab component of CHEM2031 within the past three years (see below, section 5.3).

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

Ethical Practice: Students are expected to conduct themselves in a sensible and ethical manner, especially with regard to avoiding plagiarism, and in computer use, including the use of email and online discussion forums.

5.3 Submission of assessment tasks

Assessment Submission: All lab submissions and assignments must be submitted online by the due date and time via Moodle and may be subject to plagiarism checks. Late submissions will be accepted but carry a 10% penalty per day (or part thereof) up to one week (7 days) late, after which a 100% penalty will then be applied (weekends and public holidays **do count** in determining late penalties). The penalty is applied to the total for the assignment not to the mark obtained (Example 1: you submit a report 2 days late but would have scored 70% if it was on-time, your mark will be adjusted to 50% given the 20% late penalty; Example 2: if you submit a report late by 10 minutes, you will lose 10% of the maximum possible mark – i.e. 70% becomes 60%). Extensions of deadlines will only be granted following approved application to the central special consideration unit (if eligible). This information is also available on Moodle.

Assessment Procedures: Exemption for practical classes can be given to repeating students providing they have completed the course to a satisfactory level within the past 3 years. Applications for exemption should be made to the Course Coordinator, Dr Martin Peeks, via email, before the start of session. Permission will not normally be given for students to swap laboratory classes nor attend 12 make up classes. Any requests based on medical grounds should be addressed to the Course Coordinator, but permission should not be assumed.

6. Academic integrity, referencing and plagiarism

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.[1] 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 and **plagiarism** can be located at:

- The *Current Students* site https://student.unsw.edu.au/plagiarism**,** and
- The *ELISE* training site http://subjectguides.library.unsw.edu.au/elise/presenting

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

7. Readings and resources

Text Books	Housecroft and Sharpe: Inorganic Chemistry, 5th Edition, 2018 (earlier editions also useful) **Publisher**: Pearson Education Limited, Harlow, UK **Format**: Paperback **ISBN**: 9781292134147
Course & Practical Manuals	Moodle website (CHEM2031)
Required Reading	None
Useful Additional Reading	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) Others will be advised by individual lecturers
Recommended Internet Sites	Moodle website As notified by individual lecturers Laboratory: Safety Data Sheets (SDSs) for risk assessment may be obtained from the following site: https://safety.unsw.edu.au/chemalert-0 Additionally, the UNSW School of Chemistry website http://www.chem.unsw.edu.au/local contains direct links to many important chemistry-related websites and databases. School of Chemistry website (www.chemistry.unsw.edu.au)
Societies	Royal Australian Chemical Institute http://www.raci.org.au/ Students of Chemistry Society (UNSW) http://www.chem.unsw.edu.au/schoolinfo/socs.html UNSW Chemical Society
Computer Laboratories or Study Spaces	N/A

[1] International Center for Academic Integrity, 'The Fundamental Values of Academic Integrity', T. Fishman (ed), Clemson University, 2013.

8. Administrative matters

Course contact: Dr Martin Peeks (m.peeks@unsw.edu.au)

Equipment Required	You will require an exercise book (recommended A4 size, 24 or 48 pages) for use as a laboratory notebook. Laboratory coat, safety glasses*, **face mask,** and enclosed shoes are required in all School of Chemistry laboratories. Open-weave shoes (e.g. trainers or gym shoes) should not be worn in the lab since they provide limited spill-protection. * If you wear prescription glasses you must wear overglasses (goggles that enclose your prescription glasses and protect against side and frontal impact) or prescription glasses with side shields.
Enabling Skills - training which may be required to complete this course	Health and Safety briefing (as part of lab induction) Awareness of UNSW plagiarism guidelines (see below). Each experiment has a safety exercise (prelab quiz) that must be completed and before experimental work can commence. SDSs can be sourced from the websites listed above, and other safety data are supplied, and training is provided as part of the class.
Occupational Health and Safety	Information on relevant Occupational Health and Safety policies and expectations at UNSW: https://safety.unsw.edu.au/ School of Chemistry OH&S policy and requirements see laboratory manual. To be admitted to a laboratory, you must wear safety glasses meeting the minimum size requirements as posted outside all teaching laboratories, a lab coat, **a face mask**, and covered shoes (no thongs, open sandals or clogs). You must also complete all safety pre-lab work, risk assessment or other prescribed preparation relating to carrying out safe laboratory work. Visitors are not allowed to undergraduate laboratories without the permission of the lab supervisor.

9. Additional support for students

Equity and diversity	Those students who have a need for some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the Course Convenor prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equity and Diversity Unit (9385 4734 or http://www.studentequity.unsw.edu.au/). Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made. Students who have an equitable learning plan must, typically, provide a copy to the Course Convenor to ensure that all required adjustments are provided.
Grievance Policy	https://student.unsw.edu.au/complaint

	School Contact: A/Prof John Stride, Director of Teaching; j.stride@unsw.edu.au Faculty Contact: A/Prof Alison Beavis, Associate Dean (Education); a.beavis@unsw.edu.au University Contact: Refer to: https://student.unsw.edu.au/complaint

- The Current Students Gateway: https://student.unsw.edu.au/
- Academic Skills and Support: https://student.unsw.edu.au/academic-skills
- Student Wellbeing, Health and Safety: https://student.unsw.edu.au/wellbeing
- Disability Support Services: https://student.unsw.edu.au/disability-services
- UNSW IT Service Centre: https://www.it.unsw.edu.au/students/index.html