UNSW Course Outline

CHEM3061 Chemistry of Materials - 2024

Published on the 07 Feb 2024

General Course Information

Course Code : CHEM3061
Year : 2024
Term : Term 1
Teaching Period : T1
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

Chemistry is fundamental not just to the design of small molecules, but increasingly to the preparation of materials ranging from hard colloidal nanomaterials to soft complex macromolecular architectures. These materials have been used by humans throughout the ages:

from the Lycurgus Cup of ancient Rome to natural polymers such as wool and silk. This course will explore the synthesis and characterisation of such materials, as well as the physical chemistry that underpins their behaviour both in solution and in the solid state. A particular emphasis will be placed on chemistry at the interface, the modification of surfaces, and the self-assembly of block copolymers for the preparation of nanostructures materials.

Lectures and tutorials will be complemented by an integrated laboratory course involving the synthesis of gold nanoparticles and controlled radical polymers, and their combination to prepare stimuli responsive networks. A number of characterisation techniques including NMR, size exclusion chromatography, light scattering and electron microscopy will be taught through the laboratory component.

Course Aims

The aim of this course is to equip students with an understanding of the chemistry by which nano- and micro- scale materials such as hard inorganic, and self-assembled polymer particles are synthesized, characterized, and applied in modern technology.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Relate the molecular structure of polymers to self-assembly processes, hierarchical structure and macroscopic properties.
CLO2 : Prepare controlled radical polymerization reactions and predict the effect of starting conditions on reaction kinetics and degree of polymerization.
CLO3 : Employ chemicals and laboratory equipment to synthesize inorganic nanomaterials and predict the effect of starting conditions on particle physicochemical properties.
CLO4 : Perform surface modifications with polymers and nanomaterials and evaluate changes in macroscopic properties.
CLO5 : Analyze the properties of nanomaterials using size exclusion chromatography, light scattering techniques, spectroscopy and electron microscopy.
CLO6 : Evaluate primary literature papers critically and use this knowledge to develop a proposal for a new technology or product.
CLO7 : Demonstrate group work and presentation skills disseminating knowledge and ideas associated with the technology/product.

Course Learning Outcomes	Assessment Item
CLO1 : Relate the molecular structure of polymers to self-assembly processes, hierarchical structure and macroscopic properties.	• Final Exam • Research paper assignment • Lab Activities
CLO2 : Prepare controlled radical polymerization reactions and predict the effect of starting conditions on reaction kinetics and degree of polymerization.	• Lab Activities
CLO3 : Employ chemicals and laboratory equipment to synthesize inorganic nanomaterials and predict the effect of starting conditions on particle physicochemical properties.	• Midterm Test • Lab Activities
CLO4 : Perform surface modifications with polymers and nanomaterials and evaluate changes in macroscopic properties.	• Final Exam • Research paper assignment • Lab Activities
CLO5 : Analyze the properties of nanomaterials using size exclusion chromatography, light scattering techniques, spectroscopy and electron microscopy.	• Final Exam • Research paper assignment • Lab Activities
CLO6 : Evaluate primary literature papers critically and use this knowledge to develop a proposal for a new technology or product.	• Midterm Test • Research paper assignment
CLO7 : Demonstrate group work and presentation skills disseminating knowledge and ideas associated with the technology/product.	• Research paper assignment

Learning and Teaching Technologies

Moodle - Learning Management System

Additional Course Information

See Lab Manual in Moodle for all Laboratory information, such as Lab Schedule and rubrics for laboratory reports.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Final Exam Assessment Format: Individual	25%	
Research paper assignment Assessment Format: Group	20%	
Midterm Test Assessment Format: Individual	15%	
Lab Activities Assessment Format: Individual	40%	

Assessment Details

Final Exam

Assessment Overview

The final exam is designed to summarise your learning and problem-solving skills on all topics delivered across the term, including material from lectures, tutorials and laboratory.

The exam is typically 2hrs 10 minutes and consists of MCQ, short numerical and short answer responses - details will be confirmed during the course.

The examination will occur during the official university examination period. Feedback is available through inquiry with the course convenor.

Hurdle: you must achieve >35% on the exam to receive a passing grade in the course.

Course Learning Outcomes

- CLO1 : Relate the molecular structure of polymers to self-assembly processes, hierarchical structure and macroscopic properties.

- CLO4 : Perform surface modifications with polymers and nanomaterials and evaluate changes in macroscopic properties.
- CLO5 : Analyze the properties of nanomaterials using size exclusion chromatography, light scattering techniques, spectroscopy and electron microscopy.

Research paper assignment

Assessment Overview

The research paper assignment provides an opportunity for you to engage in critical analysis of the literature with a final group presentation to develop project management and science communication skills.

In groups of 3-6 students, you will complete three assignments) related to research papers that will form the basis for an application pitch at the end of the term (week 10). You will study the provided papers and to find new ones relating to a chosen application area. In weeks 2, 4 and 7 you will submit a critical analysis of the strengths and weaknesses of each paper, guided by a set of questions (5% each; 15% total).

You are expected to use ideas from these papers to formulate a pitch which you will convey to the academic staff in week 7. In week 10 you will present the pitch as a group during a scheduled tutorial (5%). Feedback will be provided throughout the term during tutorials, and after each assessment and the presentations.

Course Learning Outcomes

- CLO1 : Relate the molecular structure of polymers to self-assembly processes, hierarchical structure and macroscopic properties.
- CLO4 : Perform surface modifications with polymers and nanomaterials and evaluate changes in macroscopic properties.
- CLO5 : Analyze the properties of nanomaterials using size exclusion chromatography, light scattering techniques, spectroscopy and electron microscopy.
- CLO6 : Evaluate primary literature papers critically and use this knowledge to develop a proposal for a new technology or product.
- CLO7 : Demonstrate group work and presentation skills disseminating knowledge and ideas associated with the technology/product.

Midterm Test

Assessment Overview

The midterm test is designed to summarise your learning and problem-solving skills on materials covered in Weeks 1-4 and is held during Week 5.

The test is typically 60 minutes in duration and consists of MCQ, short numerical and short answer responses - details will be confirmed during the course. Feedback is provided within two weeks of completing the test.

Hurdle: you must achieve a combined mark of >35% on the midterm test and final exam to receive a passing grade in the course.

Course Learning Outcomes

- CLO3 : Employ chemicals and laboratory equipment to synthesize inorganic nanomaterials and predict the effect of starting conditions on particle physicochemical properties.
- CLO6 : Evaluate primary literature papers critically and use this knowledge to develop a proposal for a new technology or product.

Lab Activities

Assessment Overview

During the laboratory program you will complete aset of three large experiments that are assessed in three ways: (1) pre-lab quizzes that must be completed prior to starting each laboratory (3 quizzes; 4% each; 12% total mark), (2) post-lab reports from questions in the laboratory manual (2 reports; 4% each; 8% total mark), and (3) a final report structured like a research paper that presents the results of the entire laboratory (20% total mark).

Post-lab reports will be due approximately one week after the final lab session for each experiment (week 4 and 7). Feedback will be provided through comments on the submitted post-lab questions within 10 days of submission.

The final lab report will be due at the end of week 10.

Hurdle: You must attend a minimum of 6/8 laboratory classes to meet the pass.

Course Learning Outcomes

- CLO1 : Relate the molecular structure of polymers to self-assembly processes, hierarchical structure and macroscopic properties.
- CLO2 : Prepare controlled radical polymerization reactions and predict the effect of starting conditions on reaction kinetics and degree of polymerization.
- CLO3 : Employ chemicals and laboratory equipment to synthesize inorganic nanomaterials and predict the effect of starting conditions on particle physicochemical properties.
- CLO4 : Perform surface modifications with polymers and nanomaterials and evaluate changes in macroscopic properties.
- CLO5 : Analyze the properties of nanomaterials using size exclusion chromatography, light scattering techniques, spectroscopy and electron microscopy.

General Assessment Information

Any assessment task submitted past the due date will incur a 10% per day penalty up to a maximum of 7 days. After 7 days a mark of 0% will be awarded however students may still submit work after this period at the discretion of the unit coordinator to receive feedback. Penalties will be applied to any day in excess of the due date including weekends, public holidays and non-teaching periods.

Extensions for any assessment item will require application for Special Consideration through the UNSW formal channels.

Grading Basis

Standard

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 12 February - 18 February	Topic	Section A: Colloidal nanoparticles (RT)
	Lecture	Introduction to nanoparticles (AuNPs, QDs, micelles, vesicles) and their synthesis including nucleation / growth and controlling particle shape.
	Lecture	Optical properties of hard NPs (SPR etc) and their characterisation (EM and XRD etc).
Week 2 : 19 February - 25 February	Lecture	Colloidal and steric stability, and controlling the surface chemistry of NPs (DLVO, Hofmeister series).
	Laboratory	AuNP synthesis
	Topic	Section B: Polymer Chemistry (MS)
	Lecture	Introduction to polymers, dispersity, and step growth polymerization
Week 3 : 26 February - 3 March	Lecture	Introduction to Chain growth polymerization with a focus on free radical polymerization and copolymerization
	Laboratory	AuNP synthesis
Week 4 : 4 March - 10 March	Lecture	Introduction to Chain growth polymerization with a focus on free radical polymerization and copolymerization
	Laboratory	Controlled radical polymerisation and vesicle/micelle formation
	Topic	Section C: Polymer physics 1 (MS)
	Lecture	Polymers in the solid state; crystalline and amorphous polymers
Week 5 : 11 March - 17 March	Lecture	Polymers in the solid state; crystalline and amorphous polymers
	Laboratory	Controlled radical polymerisation and vesicle/micelle formation
	Topic	Section C: Polymer physics 2 and self assembly (AW)
	Lecture	Polymer characterisation: How big is a polymer? Flory Huggins theory and thermodynamics.
Week 6 : 18 March - 24 March	Other	Flexibility week - No classes
Week 7 : 25 March - 31 March	Lecture	Characterization of colloidal and nano materials by light scattering (DLS, MALS).
	Laboratory	Characterisation of Polymers, AuNPs and conjugates (UV-Vis, TEM, DLS and GPC)
Week 8 : 1 April - 7 April	Lecture	Self assembly of polymers and comparison with colloids and biological materials.
	Laboratory	Characterisation of Polymers, AuNPs and conjugates (UV-Vis, TEM, DLS and GPC)
	Topic	Section D: The chemistry of biological materials and the biomaterials interface (KK)
	Lecture	Introduction to modern biomaterials science and engineering
Week 9 : 8 April - 14 April	Lecture	Biological materials – central dogma, polymers in biology
	Laboratory	Characterisation of Polymers, AuNPs and conjugates (UV-Vis, TEM, DLS and GPC)
Week 10 : 15 April - 21 April	Lecture	Bioconjugation essentials – from proteins to hydrogels to surfaces
	Laboratory	Characterisation of Polymers, AuNPs and conjugates (UV-Vis, TEM, DLS and GPC)
	Lecture	Biomaterials for drug delivery, bioprinting, and tissue engineering

Attendance Requirements

Students are expected to attend 90% of lectures/workshops and complete all laboratory tasks satisfactorily.

The student is expected to prepare the lab by reading and understanding the theoretical

background and complete all the pre-quiz questions. Students are expected to follow the UNSW policy governing the use of email, social networks and discussion forums.

General Schedule Information

RT=Richard Tilley; MS=Martina Stenzel; AW=Anna Wang; KK=Kris Kilian

Course Resources

Prescribed Resources

Suggested text book: “Principles of Polymerization”; George Odian; ISBN: 978-0-471-27400-1.

All other readings will be supplied through moodle or otherwise provided by lecturers. Computer laboratories and study spaces are available in the Gibson computer laboratory (Ground floor, Dalton building).

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Kristopher Kilian				By appointment	Yes	Yes
Lecturer	Anna Wang				By appointment	No	No
	Martina Stenzel				By appointment	No	No
	Richard Tilley				By appointment	No	No
	Sina Jamali				By appointment	No	No
Convenor	Felix Rizzuto				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)