CEIC8104

Topics in Polymer Technology

Term Two // 2021

School of Chemical Engineering // UNSW Engineering

Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Per Zetterlund	p.zetterlund@unsw.edu.au	Contact via email		0413714431

Lecturers

Name	Email	Availability	Location	Phone
Cyrille Boyer	cboyer@unsw.edu.au	Contact via email		

School Contact Information

For assistance with enrolment, class registration, progression checks and other administrative matters, please see the Nucleus: Student Hub. They are located inside the Library – first right as you enter the main library entrance. You can also contact them via http://unsw.to/webforms or reserve a place in the face-to-face queue using the UniVerse app.

If circumstances outside your control impact on submitting assessments, Special Consideration may be granted, usually in the form of an extension or a supplementary assessment. Applications for Special Consideration must be submitted online.

For course administration matters, please contact the Course Coordinator.

Course Details

Credit Points 6

Summary of the Course

POLY3000/CEIC8104 focuses primarily on the chemical reactions, mechanisms, and industrial techniques for synthesis of industrially important polymeric materials. While the course will deal primarily with chemistry, some polymer physics and properties will also be discussed. Furthermore, the course is designed as introductory classes for students with no to limited prior knowledge about polymers. The course will start with an introduction to polymer science. In this segment, we will learn what constitutes a polymer, what different classes of polymers exist and what general polymerisation strategies are open to the industrial chemist. The course will cover topics such as step and chain polymerisation, including polycondensation, polyaddition, cationic and anionic chain polymerisation as well as radical polymerisation. We will also study copolymerisation in greater depth due to its industrial importance. In addition, we will discuss methods to analyse polymers, such as size exclusion chromatography. The course will finish with basic structure-property relationships for polymers, as well as introduce the concept of viscoelastic materials – the cornerstone for rubbers, elastomers, and thermoplastic materials.

Course Aims

This course is designed to give insight into the fundamentals of polymer science and therefore suitable for everybody without prior knowledge in polymers. The course is of particular appeal to students interested in basic polymer chemistry as well as polymer related areas such as material science and the coating/paint industry, nanotechnology, biomaterials, membrane and separation science, as well as the packaging material industries.

Course Learning Outcomes

After successfully completing this course, you should be able to:

Learning Outcome	EA Stage 1 Competencies
1. Identify the main different types of polymers and how they are typically synthesized	PE1.1, PE1.3
2. Describe fundamental mechanisms related to polymerisation via the main types of polymerisation, and how polymerisation methods/conditions can be related to polymer structure / characteristics (e.g. molecular weight)	PE1.1, PE1.3
3. Describe how main structural features of polymers determine their physical properties	PE1.1, PE1.3

Teaching Strategies

The main aim of this course is not the memorisation of content and reactions. While there are some kinetic equations that the students may wish to memorise, this course is more about understanding the underlying concepts in polymer science, and developing these concepts so as to establish broader links between polymer science and other industrial engineering subjects. To achieve this goal the student needs to be critical about the content of the course and distinguish between information only and bigger

concepts, which help to apply knowledge to new challenges, which the students have never been exposed to before.

There are a number of different learning/teaching activities:

1. Traditional lectures, where the lecturer will explain the material using power point slides. These slides will all be delivered digitally, and will be available in Moodle.
2. Workshops: Problems to work on (worksheet) will be available on Moodle for each week. The idea is that the students work on these problems before/during class, at which time the lecturer with explain/elaborate on how to solve the problems / answer the questions. These workshops will comprise a significant interactive element, and will be implemented via Microsoft Teams.
3. Assignments: Three assignments will be given – each is to be completed and submitted in a timely fashion as per instructions provided during the course.

Additional Course Information

N/A

Assessment

Assessment Tasks

Assessment task	Weight	Due Date	Student Learning Outcomes Assessed
Assignment 1	15%	Not Applicable	1, 2, 3
Assignment 2	15%	Not Applicable	1, 2, 3
Assignment 3	15%	Not Applicable	
Final Exam	55%	Not Applicable	1, 2, 3

Assessment Details

Assessment 1: Assignment 1

Start date: Not Applicable

Details:

The students are given a range of exercises and challenges on polymer synthesis to be answered individually. The student is required to complete the task using lecture notes and text books. The student should demonstrate capability of applying the theoretical background to specific problems.

The focus of Assignment 1 is the basics of polymer science, including fundamental concepts.

Assessment 2: Assignment 2

Start date: Not Applicable

Details:

The students are given a range of exercises and challenges on polymer synthesis to be answered individually. The student is required to complete the task using lecture notes and text books. The student should demonstrate capability of applying the theoretical background to specific problems.

The focus of Assignment 2 will be various synthetic aspects of chainwise and stepwise polymerization methods.

Assessment 3: Assignment 3

Details:

The students are given a range of exercises and challenges on polymer synthesis to be answered individually. The student is required to complete the task using lecture notes and text books. The student

should demonstrate capability of applying the theoretical background to specific problems.

Assignment 3 will focus on synthetic aspects of ionic polymerization, including structure/reactivity relationships.

Assessment 4: Final Exam

Start date: Not Applicable

Details: Final Exam

Attendance Requirements

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

Course Schedule

View class timetable

Timetable

Date	Type	Content
O Week: 25 May - 28 May		
Week 1: 31 May - 4 June	Online Activity	Basic concepts of polymers/polymerisation.
Week 2: 7 June - 11 June	Online Activity	Step polymerisation
	Workshop	Step polymerisation
Week 3: 14 June - 18 June	Online Activity	Step polymerisation
	Workshop	Step polymerisation
Week 4: 21 June - 25 June	Online Activity	Chain polymerisation: Radical polymerisation
	Workshop	Chain polymerisation: Radical polymerisation
Week 5: 28 June - 2 July	Online Activity	Chain polymerisation: Radical polymerisation
	Workshop	Chain polymerisation: Radical polymeriation
Week 6: 5 July - 9 July	Online Activity	Flexibility Week
Week 7: 12 July - 16 July	Online Activity	Chain Polymerisation: Radical polymerisation Structure-Property Relationships
	Workshop	Chain Polymerisation: Radical polymerisation Structure-Property Relationships
Week 8: 19 July - 23 July	Online Activity	Chain Polymerisation: Ionic polymerisation
	Workshop	Chain Polymerisation: Ionic polymerisation
Week 9: 26 July - 30 July	Online Activity	Chain Polymerisation: Ionic polymerisation
	Workshop	Chain Polymerisation: Ionic polymerisation
Week 10: 2 August - 6 August	Online Activity	Metallocene and Insertion Polymerisation
	Workshop	Metallocene and Insertion Polymerisation

Resources

Prescribed Resources

Principles of Polymerization by Odian is the “gold standard” of polymer chemistry, and will be the primary source of material for much of the course. However, several other textbooks will also be employed. Examination of any of the following introductory textbooks is highly recommended, with the more heavily applicable textbooks to the course marked with an asterisk (*).

- *Odian, G, *Principles of Polymerization*, 3rd Ed., Wiley
- *Sperling, L H, *Introduction to Physical Polymer Science*, 2nd Ed, Wiley
- *Billmeyer, F W, *Textbook of Polymer Science*, 3rd Ed, Wiley
- Stevens, M P, *Polymer Chemistry, An Introduction*, 3rd Ed., Oxford
- *Rodriguez, F, *Principles of Polymer Systems*, 3rd Ed., hpc
- Brydson, J A, *Plastics Materials*, 5,6 or 7th Ed, Butterworths
- Allcock H R and Lampe, F W, *Contemporary Polymer Chemistry*, 3rd Ed., Prentice Hall
- Rudin, A., *Elements of Polymer Science and Engineering*, Academic Press
- Elias, H-G, *An Introduction to Polymer Science*, VCH

- The course is based on the lecture material.
- The students are expected to attend the lectures since the lecture notes provided cannot replace attendance. Students are encouraged to ask questions during the lecture. However, if questions are not answered to the satisfaction of the student, the student is required to use textbooks or other resources.
- The tutorial is designed to be interactive. The students are expected to prepare the answers to the tutorial questions independently at home. During the tutorial, the students will discuss the tutorial questions together with the tutor. The tutorial should be a forum for discussion, which should allow students to clarify remaining questions from the lecturer. The tutorial should also provide feedback to the tutor.

Recommended Resources

Course Evaluation and Development

MyExperience

Submission of Assessment Tasks

In the School of Chemical Engineering, all written work will be submitted for assessment via Moodle unless otherwise specified. Attaching cover sheets to uploaded work is generally not required; when you submit work through Moodle for assessment you are agreeing to uphold the Student Code.

Some assessments will require you to complete the work online and it may be difficult for the course coordinator to intervene in the system after the due date. You should ensure that you are familiar with assessment systems well before the due date. If you do this, you will have time to get assistance before the assessment closes.

All submissions are expected to be neat and clearly set out. Your results are the pinnacle of all your hard work and should be treated with due respect. Presenting results clearly gives the marker the best chance of understanding your method; even if the numerical results are incorrect.

Marking guidelines for assignment submissions will be provided at the same time as assignment details to assist with meeting assessable requirements. Submissions will be marked according to the marking guidelines provided.

Late penalties

Unless otherwise specified, submissions received after the due date and time will be penalised at a rate of 10% per day or part thereof (including weekends). For some activities including Moodle quizzes and Team Evaluation surveys, extensions and late submissions are not possible.

Special consideration

If you have experienced an illness or misadventure beyond your control that will interfere with your assessment performance, you are eligible to apply for Special Consideration prior to submitting an assessment or sitting an exam.

UNSW has a Fit to Sit / Submit rule, which means that if you attempt an exam or submit a piece of assessment, you are declaring yourself fit enough to do so and cannot later apply for Special Consideration.

For details of applying for Special Consideration and conditions for the award of supplementary assessment, please see the information on UNSW's Special Consideration page.

Please note that students will **not** be required to provide **any** documentary evidence to support absences from any classes missed **because of COVID-19 public health measures such as isolation**. UNSW will **not** be insisting on medical certificates from anyone deemed to be a positive case, or when they have recovered. Such certificates are difficult to obtain and put an unnecessary strain on students and medical staff.

Applications for special consideration **will** be required for assessment and participation absences – but no documentary evidence **for COVID 19 illness or isolation** will be required.

Academic Honesty and Plagiarism

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 (International Center for Academic Integrity, 'The Fundamental Values of Academic Integrity', T. Fishman (ed), Clemson University, 2013). 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
- The ELISE training site

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.

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.

For assessments in the School of Chemical Engineering, we recommend the use of referencing software such as Mendeley or EndNote for managing references and citations. Unless required otherwise specified (i.e. in the assignment instructions) students in the School of Chemical Engineering should use either the APA 7th edition, or the American Chemical Society (ACS) referencing style as canonical author-date and numbered styles respectively.

Academic Information

To help you plan your degree, assistance is available from academic advisors in The Nucleus and also in the School of Chemical Engineering.

Additional support for students

- Current Student Gateway
- Engineering Current Student Resources
- Student Support and Success
- Academic Skills
- Student Wellbeing, Health and Safety
- Equitable Learning Services
- IT Service Centre

Course workload

Course workload is calculated using the Units-Of-Credit (UOC). The normal workload expectation for one UOC is approximately 25 hours per term. This includes class contact hours, private study, other learning activities, preparation and time spent on all assessable work.

Most coursework courses at UNSW are 6 UOC and involve an estimated 150 hours to complete, for both regular and intensive terms. Each course includes a prescribed number of hours per week (h/w) of scheduled face-to-face and/or online contact. Any additional time beyond the prescribed contact hours should be spent in making sure that you understand the lecture material, completing the set assignments, further reading, and revising for any examinations.

On-campus class attendance

Physical distancing recommendations must be followed for all face-to-face classes. To ensure this, only students enrolled in those classes will be allowed in the room. Class rosters will be attached to corresponding rooms and circulated among lab demonstrators and tutors. No over-enrolment is allowed in face-to-face class. Students enrolled in online classes can swap their enrolment from online to a **limited** number of on-campus classes by Sunday, Week 1.

In certain classroom and laboratory situations where physical distancing cannot be maintained or the staff running the session believe that it will not be maintained, face masks will be designated by the course coordinator as **mandatory PPE** for students and staff. Students are required to bring and use their own face mask. Mask can be purchased from IGA Supermarket (Map B8, Lower Campus), campus pharmacy (Map F14, Middle Campus), the post office (Map F22, Upper Campus) and a vending machine in the foyer of the Biological Sciences Building (Map E26, Upper Campus).

Your health and the health of those in your class is critically important. You must stay at home if you are sick or have been advised to self-isolate by NSW health or government authorities. Current alerts and a list of hotspots can be found here. Do not come to campus if you have any of the following symptoms: fever (37.5 °C or higher), cough, sore throat, shortness of breath (difficulty breathing), runny nose, loss of taste, or loss of smell. If you need to have a COVID-19 test, you must not come to campus and remain in self-isolation until you receive the results of your test.

You will not be penalised for missing a face-to-face activity due to illness or a requirement to self-

isolate. We will work with you to ensure continuity of learning during your isolation and have plans in place for you to catch up on any content or learning activities you may miss. Where this might not be possible, an application for fee remission may be discussed. Further information is available on any course Moodle or Teams site.
For more information, please refer to the FAQs: https://www.covid-19.unsw.edu.au/safe-return-campus-faqs

Image Credit

Dr Peter Wich

CRICOS

CRICOS Provider Code: 00098G

Acknowledgement of Country

We acknowledge the Bedegal people who are the traditional custodians of the lands on which UNSW Kensington campus is located.

Appendix: Engineers Australia (EA) Professional Engineer Competency Standard

Program Intended Learning Outcomes	
Knowledge and skill base	
PE1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline	✓
PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline	
PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline	✓
PE1.4 Discernment of knowledge development and research directions within the engineering discipline	
PE1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline	
PE1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline	
Engineering application ability	
PE2.1 Application of established engineering methods to complex engineering problem solving	
PE2.2 Fluent application of engineering techniques, tools and resources	
PE2.3 Application of systematic engineering synthesis and design processes	
PE2.4 Application of systematic approaches to the conduct and management of engineering projects	
Professional and personal attributes	
PE3.1 Ethical conduct and professional accountability	
PE3.2 Effective oral and written communication in professional and lay domains	
PE3.3 Creative, innovative and pro-active demeanour	
PE3.4 Professional use and management of information	
PE3.5 Orderly management of self, and professional conduct	
PE3.6 Effective team membership and team leadership	