Course Outline

MATS6109

Polymer Materials Science

Materials Science and Engineering

Science

T2, 2022

1. Staff

Position	Name	Email	Consultation times and locations	Contact Details
Course Convenor	Dr Tushar Kumeria	t.kumeria@unsw.edu.au	Room 242, School of Materials Science and Engineering (Building E10)	By email
Lecturer	Dr Damia Mawad	damia.mawad@unsw.edu.au	Room 246, School of Materials Science and Engineering (Building E10)	By email

2. Course information

Units of credit: 6

Pre-requisite(s): None

Timetabling website: http://timetable.unsw.edu.au/2022/MATS6109.html

2.1 Course summary

1st Component: Fundamentals of Polymer Science and Engineering

- **Polymer Chemistry and Synthesis:** raw materials and synthesis of polymers; monomers, homopolymers, copolymers; basic organic chemistry and applied polymer chemistry; free radical polymerisation, kinetics and mechanism; ionic and condensation polymerisation, kinetics and mechanism.
- **Polymer Physics and Characterisation:** chain dimensions; polymer thermodynamics; polymer solution behaviour; characterisation techniques in solution and solid state using spectroscopy, chromatography and colligative properties.

2nd Component: Case Studies of Polymer Design and Failure

- **Mechanical Properties***:* viscoelasticity and elastic deformation; structure-property relationship **Case Studies:** polymer properties; failure modes and causes of degradation; analytical techniques for characterising the failing components; examples of polymeric devices that have failed across a broad range of applications such as medical and industrial.
- **Design Project:** field of application; material selection (synthetic route); polymer structure and property; processing technique; characterisation tools; the relation between structure and application.

2.2 Course aims

- To introduce the students to polymers, their synthesis, reaction mechanism and kinetics.
- To provide the students with an understanding of polymer behaviour in the solid and solution state; as well as characterisation techniques commonly used in polymer science.
- To teach the students basic concepts related to the mechanical/viscoelastic properties of polymers.
- To engage the students with current issues (design and failure) related to polymeric products, making their learning relevant to real-world situations.

- To design a polymeric product including aspects of synthesis, processing, structural and mechanical properties applied for a particular application.

2.3 Course learning outcomes (CLO)

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

1. Understand the principles underlying the synthesis and processing of polymeric materials.
2. Articulate the common strategies used to optimise the mechanical properties of polymeric materials and their resultant structure/property relationship.
3. Assess critically case studies of failure of commodity polymers
4. Design a polymeric product including material selection, properties, processing, and characterisation methods

2.4 Relationship between course and program learning outcomes and assessments

Course Learning Outcome (CLO)	LO Statement	Program Learning Outcome (PLO)	Related Tasks & Assessment
CLO 1	Understand…	3,4,5	Assignment Part 1, Midterm Exam
CLO 2	Articulate…	1,3,4,5	Assignment Part 2, Research paper, design project
CLO 3	Assess…	1,3,4,5	Research paper, design project
CLO 4	Design…	1,3,4,5	all

3. Strategies and approaches to learning

3.1 Learning and teaching activities

(based on UNSW Learning Guidelines)

- *Students are actively engaged in the learning process.*

  It is expected that, in addition to attending classes, students will read, write, discuss, and engage in analysing the course content.

- *Effective learning is supported by a climate of inquiry where students feel appropriately challenged.*

  Students are expected to be challenged by the course content and to challenge their own preconceptions, knowledge, and understanding by questioning information, concepts, and approaches during class and study.

- *Learning is more effective when students' prior experience and knowledge are recognised and built on.*

  Coursework, tutorials, assignments, laboratories, examinations, and other forms of learning and assessment are intended to provide students with the opportunity to cross-reference these activities in a meaningful way with their own experience and knowledge.

- *Students become more engaged in the learning process if they can see the relevance of their*

studies to professional and disciplinary contexts

The course content is designed to incorporate both theoretical and practical concepts, where the latter is intended to be applicable to real-world situations and contexts.

3.2 Expectations of students

- Students must attend at least 80% of all classes with the expectation that students only miss classes due to illness or unforeseen circumstances.
- Students must read through lecture notes and lab sheets prior to class.
- During class, students are expected to engage actively in class discussions.
- Students should work through lecture, tutorial and textbook questions.
- Students should read through the relevant chapters of the prescribed textbook.
- Students should complete all assessment tasks and submit them on time.
- Students are expected to participate in online discussions through the Moodle page

4. Course schedule and structure

This course consists of 36 hours of class contact hours. You are expected to take an additional 114 hours of non-class contact hours to complete assessments, readings, and exam preparation.

Week	Topics	Activity
1	Introduction to Polymers Morphology/Types of Polymers Radical Polymerisation	
2	Condensation / Ionic Polymerisation Polymer Thermodynamics I	Formative quiz
3	Polymer Thermodynamics II Characterisation of Polymers: Polymers in Solutions	
4	Characterisation of Polymers: MW, Light Scattering Elastomers	Assignment Part 1
5	Guest Lecture: Intro to spectroscopy Revision	Mid-term exam
6		
7	Mechanical properties	
8	Case study-polymer design/mechanical and thermal failure	Assignment Part 2
9	Case study-polymer design/photodegradation and chemical failure Case study-polymer design/biodegradation and electrical failure	Research Paper
10		

5. Assessment

5.1 Assessment tasks

Assessment task	Description	Weight	Due date
Formative quiz:	In-class quiz to assess how the students are understanding the concepts taught within weeks 1-3. This will provide students feedback on how they are progressing in the course before the Census date	0%	Week 3
Assignment:	Part one: assesses the content taught in lectures 1-8 Part two: assesses the content taught in lectures 12-13	15% 10%	Part 1: Week 4 Part 2: Week 8
Mid-term exam:	In-class exam covering the content taught in lectures 1-11	30%	Week 5
Research paper:	Critical Review of a Research Paper relevant to the design project: Analysis of a commodity polymer, its mechanical properties and degradation modes	15%	Week 9
Design Project:	Group Report on the Design of a Commodity Polymer	30%	Final exam period, see Moodle for details

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

Assessment criteria and standards for each assessment tasks are available on the course Moodle page.

NOTE: Satisfactory completion of the course includes the requirement to achieve > 35% in the mid-term exam and > 35% in the final exam (Design Project for MATS6109), and > 45% weighted average over the two exams. Students who fail to achieve this will be awarded an Unsatisfactory Fail (UF) grade for the course regardless if they receive over 50% in total for the course.

Please refer to the UNSW guide to grades: https://student.unsw.edu.au/grades

5.3 Submission of assessment tasks

- UNSW operates under a Fit to Sit/ Submit rule for all assessments. If a student wishes to submit an application for special consideration for an exam or assessment, the application must be submitted prior to the start of the exam or before an assessment is submitted. If a student sits the exam/ submits an assignment, they are declaring themselves well enough to do so. Information on this process can be found here: https://student.unsw.edu.au/special-consideration. Medical

certificates or other appropriate documents must be included. Students should also advise the lecturer of the situation.

- Unless otherwise specified in the task criteria, all assignments must be uploaded via Moodle prior to the due date for submission.
- Assignments/research paper/design project submitted after the due date for submission will receive a penalty of 5% of the maximum grades per day, capped at five days (120 hours) from the original assessment submission deadline, after which the students cannot submit an assessment, and no variations will be permitted.
- Students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course coordinator prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equity and Diversity Unit: https://student.unsw.edu.au/disability. Early notification is essential to enable any necessary adjustments to be made.
- Rules governing conduct during exams are given at: https://student.unsw.edu.au/exam-rules

5.4. Feedback on assessment

Assignment and research paper: Feedback will be given two weeks after submission of the assignment and take the form of the mark for the assignment, overall comments on how the class performed, any common areas that were not answered correctly. Additionally, personal feedback and how each student performed may be given.

Midsession exams: Students will receive their marked exams indicating what questions were answered correctly and incorrectly. Overall comments and worked solutions may be provided to the class.

Design project: Students will receive their final mark.

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.

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

7. Readings and resources

Recommended Textbook*

1st component of the course:

- R.J. Young & P.A. Lovell. Introduction to Polymers, 3rd Ed. CRC Press, 2011.

2nd component of the course:

- D. Wright. Failure of Plastics and Rubber Products. Causes, Effects, and Case Studies Involving Degradation. Rapra Technology Ltd., 2006
- P.R. Lewis & C. Gagg. Forensic Polymer Engineering. CRC Press, 2010.

References

- M. Chanda. Introduction to Polymer Science and Chemistry, 2nd Ed. CRC Press, 2013
- I.M. Ward & J. Sweeney. An Introduction to the Mechanical Properties of Solid Polymers, 2nd Ed. John Wiley & Sons, 2008
- N.G. McCrum, C.P. Buckley, and C.B. Bucknall. Principles of Polymer Engineering, 2nd Ed, Oxford University Press, 1997
- D. Wright. Failure of Plastics and Rubber Products. Rapra Technology Ltd., 2001

8. Administrative matters

School Office: Room 137, Building E10 School of Materials Science and Engineering
School Website: http://www.materials.unsw.edu.au/
Faculty Office: Robert Webster Building, Room 128
Faculty Website: http://www.science.unsw.edu.au/

9. Additional support for students

- 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
- Assessment Implementation Procedure: https://www.gs.unsw.edu.au/policy/documents/assessmentimplementationprocedure.pdf
- Special Consideration: https://student.unsw.edu.au/special-consideration