Course Outline

MATS3004

Polymer Science and Engineering 1

Materials Science and Engineering

Science

T2, 2022

1. Staff

Position	Name	Email	Consultation times and locations	Contact Details
Course Convenor and Lecturer	Dr. Damia Mawad	damia.mawad@unsw.edu.au	Room 246, School of Materials Science and Engineering (Building E10)	Phone: 9385 6642 By Email

2. Course information

Units of credit: 6

Pre-requisite(s): None

Timetabling website: http://timetable.unsw.edu.au/2021/MATS3004.html

2.1 Course summary

The course is divided into 4 sections:

Polymer Chemistry and Synthesis: raw materials and synthesis of polymers; monomers, homopolymers, copolymers; basic organic chemistry and applied polymer chemistry; free radical polymerization, kinetics, and mechanism; ionic and condensation polymerization, kinetics, and mechanism.

Polymer Physics and Characterization: chain dimensions; polymer thermodynamics; polymer solution behavior; characterization techniques in solution and solid-state using spectroscopy, chromatography, and colligative properties.

Polymer morphology and physico-chemical properties: amorphous and crystalline states; multicomponent systems; iso-free volume theory; mechanical, physical, and chemical properties in relation to bulk morphology; online lab component that complements the theory learned in class with focus on the properties of polymers.

Commodity and specialty plastics: compositions and fabrication; additives in plastics; commercial manufacturing processes and applications

2.2 Course aims

To develop an understanding of the fundamentals in polymer science and engineering covering:

1. the synthesis and characterization of polymers
2. the relation between chemical structure, polymer morphology and physico-chemical properties
3. technological developments in fabrication and processing techniques

The course objectives are:

- To introduce the students to polymers, their synthesis, reaction mechanism and kinetics (Lectures 1-5 + tutorial)
- 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 (Lectures 6-10 +

tutorial)

- To provide the students with basic knowledge of the morphology of polymers in the solid state, amorphous and crystalline. Emphasis will be on the interplay between morphology and physico-chemical properties (Lectures 11-14 + tutorial)
- To introduce polymer technology including processing, applications, and manufacturing of commodity polymers (Lectures 15-16)

2.3 Course learning outcomes (CLO)

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

1. Use fundamental polymer chemistry to explain and predict the synthesis of polymers as well as the resultant structure and properties.
2. Identify suitable characterization techniques based on polymer solubility and chemical structure.
3. Predict/interpret the behavior and properties of polymers as a function of their morphology and composition.
4. Evaluate technological developments in commodity and advanced polymers.

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	Use…	1.1, 1.3,	Assignment & Mid-term
CLO 2	Identify…	1.5, 2.3, 3.3, 3.6	Assignment, Mid-term exam & Lab reports
CLO 3	Predict/interpret …	2.3, 3.3, 2.2	Lab reports & Final exam
CLO 4	Evaluate…	2.1, 2.3 2.2	Final exam

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 recognized 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.

Lectures: The core concepts will be taught in lectures; students will have access to the lectures notes before class for annotation during the lecture. Students will be engaged in the learning process through class discussions and problem-solving questions independently and working together with partners and groups.

Labs: Experimental techniques and procedures will be taught online through recorded laboratories practicals. Students will be able to reflect on the experiments and learn to process data through the lab reports after class.

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 52 hours of class contact hours. You are expected to take an additional 94 hours of non-class contact hours to complete assessments, readings and exam preparation spread throughout the term.

Week	Topics	Activity
1	Introduction to Polymers Morphology/Types of Polymers Radical Polymerization	
2	Radical / Ionic Polymerization Condensation Tutorial	Formative quiz
3	Polymer Thermodynamics I Polymer Thermodynamics II Characterization of Polymers I: Polymers in Solutions	
4	Characterization of Polymers II: Molecular Weight, Light Scattering Characterization of Polymers III: Spectroscopy Tutorial	Assignment
5	Elastomers Revision	Mid-term exam
6	Amorphous Polymers Tutorial: Base Knowledge Required for the Lab Practicals	Laboratory
7	Crystalline Polymers	Laboratory
8	Mechanical Properties: Introductory level Tutorial	Laboratory
9	Polymer Processing I Polymer Processing II	Laboratory
10	Tutorial Revision	

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:	Assesses the content taught in lectures 1-8	15%	Week 4
Mid-term exam:	In-class exam covering the content taught in lectures 1-10	35%	Week 5
Group laboratory reports:	Laboratory activities will involve use of FTIR, Raman, XRD, DSC for analysis of polymers. Results and discussion of these labs to be compiled into two reports.	15%	1 final lab report
Final exam:	Exam will be 2 hours in duration Topics taught in lectures 11-16	35%	Final exam period

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

Assignment criteria will be available on the course Moodle page.

Satisfactory completion of the course includes the requirement to achieve > 35% in the mid-term exam and > 35% in the final exam, 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 rules for all assessments. If a student wishes to apply 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.
- Late submission is permitted for up to five days after the submission deadline; work submitted after this time will not be accepted.
- Late submissions will attract a penalty of 5% per day.
- 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

Assignments: 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.

Lab reports: Students will receive their mark and individualized feedback on the areas they excelled at and which areas of the reports that were not answered correctly.

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.

Final exam: 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*

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

Other useful textbooks

- M. Chanda. Introduction to Polymer Science and Chemistry, 2nd Ed. CRC Press, 2013
- P.C. Painter and M.M. Coalman. Essentials of Polymer Science and Engineering, Destech Publishers, 2009
- R.C. Progelhof. Polymer Engineering Principles, Hanser Publishers, 1993. In addition, notes and

selected reference material will be issued in lectures.

* Assistance is available from the Library: info.library.unsw.edu.au/web/services/teaching.html

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