Polymer Materials Science

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Course Staff

<table>
<thead>
<tr>
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<th>Room 246, School of Materials Science and Engineering (Hilmer Building – E10)</th>
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</thead>
<tbody>
<tr>
<td>Lecturer &amp; Course Coordinator</td>
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</tr>
<tr>
<td></td>
<td>E: <a href="mailto:damia.mawad@unsw.edu.au">damia.mawad@unsw.edu.au</a></td>
</tr>
</tbody>
</table>

Consultation hours:
By appointment
Timetable

<table>
<thead>
<tr>
<th>Weeks</th>
<th>Day</th>
<th>Time</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weeks 1 – 6</td>
<td>Monday</td>
<td>13:00 – 15:00</td>
<td>Red Centre Theatre (K-H13-G001)</td>
</tr>
<tr>
<td></td>
<td>Thursday</td>
<td>9:00 – 11:00</td>
<td>Central Lecture Block 4 (K-E19-G05)</td>
</tr>
<tr>
<td>Weeks 7 – 13</td>
<td>Monday</td>
<td>13:00 – 15:00</td>
<td>UNSW Business School 232 (E12)</td>
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Your Course at a Glance
(Any changes will be advised in class or via Moodle)

<table>
<thead>
<tr>
<th>Total Hours</th>
<th>24 (Weeks 1 – 6)</th>
<th>12 (Weeks 7 – 12)</th>
</tr>
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<tbody>
<tr>
<td>Week No.</td>
<td>Monday (13:00 – 15:00)</td>
<td>Thursday (9:00 – 11:00)</td>
</tr>
<tr>
<td>Week 1</td>
<td>Introduction to Polymers</td>
<td>Morphology/Types of Polymers</td>
</tr>
<tr>
<td>Week 2</td>
<td>Radical Polymerization</td>
<td>Condensation / Ionic Polymerization</td>
</tr>
<tr>
<td>Week 3</td>
<td>Polymer Thermodynamics I</td>
<td>Polymer Thermodynamics II</td>
</tr>
<tr>
<td>Week 4</td>
<td>Characterization of Polymers: Polymers in solutions</td>
<td>Characterization of Polymers: MW, light scattering</td>
</tr>
<tr>
<td>Week 5</td>
<td>Guest Lecture: Intro to spectroscopy</td>
<td>Elastomers</td>
</tr>
<tr>
<td>Week 6</td>
<td>Revision</td>
<td>MID TERM EXAMINATION</td>
</tr>
<tr>
<td>Week 7</td>
<td></td>
<td>Mechanical Properties</td>
</tr>
<tr>
<td>Week 8</td>
<td></td>
<td>Mechanical Properties</td>
</tr>
<tr>
<td>Week 9</td>
<td></td>
<td>Case Study-Polymer Design/Failure</td>
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</table>

Mid-session break

| Week 10 | Public Holiday |
| Week 11 | Case Study-Polymer Design/Failure |
| Week 12 | Case Study-Polymer Design/Failure |
| Week 13 | Case Study-Polymer Design/Failure |

Course Objective

MATS6109 is an elective course in the Master program, structured into two components.

- The first component (60%) will be delivered as a series of lectures. It introduces the fundamentals of polymer science and engineering, covering the synthesis, reaction mechanisms and characterisation of polymers.
- The second component (40%) will be structured around case studies of polymer design and failure with an emphasis on student participation and in class discussion. It is aimed at the “design” of a polymeric product building on the topics learned in the first component of the course and the case studies discussed in class.

The course objectives are:
- 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.

Course Content

The course is divided into 2 components:

1st Component: Fundamentals of Polymer Science and Engineering
• Polymer Chemistry and Synthesis: monomers, homopolymers, copolymers, vinyl polymers; basic organic chemistry and applied polymer chemistry; free radical polymerization, reaction and termination rates using physical chemistry models; ionic and condensation polymerization.
• Polymer Physics and Characterisation: molecular statistics of rubbery states; chain branching, networking; iso-free volume theory; properties affected by primary bonds; physical properties affected by secondary bonds; polymer thermodynamics; polymer solution behaviour; characterisation techniques such as molecular weight determination or spectroscopy

2nd Component: Case Studies of Polymer Design and Failure
• Mechanical Properties: creep and stress; yield, fracture, and breaking phenomena.
• Case Studies: polymer properties; failure modes and causes; 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; relation between structure and application; all to be included in the write-up of the project.

Assessment

<table>
<thead>
<tr>
<th>Category</th>
<th>Marks</th>
<th>Due Date</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment 1</td>
<td>10</td>
<td>End of Week 3</td>
<td>Quiz including multiple choice and problems to solve</td>
</tr>
<tr>
<td>Assessment 2</td>
<td>10</td>
<td>End of Week 5</td>
<td>Individual Assignments: Provide a written report (2 pages including figures, tables, references)</td>
</tr>
<tr>
<td>Mid-term Examination</td>
<td>30</td>
<td>Week 6</td>
<td>Exam will be 2 hours in duration</td>
</tr>
<tr>
<td>Assessment 3</td>
<td>15</td>
<td>End of Week 10</td>
<td>Critical Review of a Research Paper: Analysis of a commodity polymer and its degradation</td>
</tr>
<tr>
<td>Final Project</td>
<td>25</td>
<td>End of Week 13</td>
<td>Group Report on a Commodity Polymer</td>
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NOTE: Students who fail to achieve a score of at least 40% for the overall exam component (i.e., mid-session exam and final exam marks combined), but achieve a final mark >50% for the course, will be awarded a UF (Unsatisfactory Fail) for the course.

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

Recommended Textbook*

1st component of the course:

2nd component of the course:

References*
- M. Chanda. Introduction to Polymer Science and Chemistry, 2nd Ed. CRC Press, 2013
- D. Wright. Failure of Plastics and Rubber Products. Rapra Technology Ltd., 2001

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

Learning and Teaching Philosophy Underpinning the Course
(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.

### Course Information

<table>
<thead>
<tr>
<th>Units of credit</th>
<th>6</th>
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| **How the course relates to other course offerings and overall program(s) in the discipline** | The course is an elective course in the Materials Engineering Master program. Structured into two components, it introduces the fundamentals of polymer science and engineering, followed by case studies presenting polymeric products and their failure modes from real world situation.
Students are required to build on acquired knowledge to design a polymeric product.
The course utilizes knowledge and experience from previously studied courses in the BE program including chemistry, mathematics, physical properties of materials, materials characterization, mechanical behavior of materials, fluid flow and heat transfer, thermodynamics and phase equilibria. |

| Graduate attributes which will be gained through the course | • Ability to communicate effectively  
• Develop problem-solving and teamwork skills  
• Capacity for creativity and innovation  
• Ability to manage information and documentation  
• Understanding of professional and ethical responsibilities, and commitment to them  
• Ability to function effectively as an individual  
• Ability to work effectively in multidisciplinary and multicultural teams  
• Capacity for lifelong learning and professional development  
• Professional attitudes |

| Expected learning outcomes | In doing this course, you will learn to:  
• use fundamental polymer chemistry to explain and predict the synthesis of polymers and plastics as well as the resultant structure and properties  
• predict/interpret the behaviour and properties of plastics as a function of their composition and manufacturing conditions  
• solve problems, perform calculations, and undertake design in the area of polymer synthesis and processing  
• design a polymeric product including material selection, properties, processing characterization and methods  
You will also learn to:  
• think critically in decision making and problem-solving  
• communicate with correct terminology  
• conduct online research  
• work effectively in a team to solve case studies  
• participate in class discussions |

| Teaching strategies | • Core concepts, theories and approaches will be covered in lectures.  
• Extensive use will be made of case studies to exemplify polymer synthesis and microstructure–property relationships  
• Real-life examples and recent developments in polymer synthesis and manufacturing will be examined in the assignments  
• Teaching material, including course outline, lecture notes, assignments, case studies and course announcements are available on the Course Blackboard website. |
**Academic Honesty and Plagiarism**

**What is Plagiarism?**

All details regarding plagiarism can be found here: [https://student.unsw.edu.au/plagiarism](https://student.unsw.edu.au/plagiarism)

It is important to understand what plagiarism is. The general concept is plagiarism is using the words or ideas of others and passing them off as your own. Examples of plagiarism, including self-plagiarism, are:

- **Copying**
  
  Using the same or very similar words to the original text or idea without acknowledging the source or using quotation marks. This includes copying materials, ideas or concepts from a book, article, report or other written document, presentation, composition, artwork, design, drawing, circuitry, computer program or software, website, internet, other electronic resource, or another person’s assignment, without appropriate acknowledgement.

- **Inappropriate paraphrasing**
  
  Changing a few words and phrases while mostly retaining the original structure and/or progression of ideas of the original, and information without acknowledgement.
  
  This also applies in presentations where someone paraphrases another’s ideas or words without credit and to piecing together quotes and paraphrases into a new whole, without appropriate referencing.

- **Collusion**
  
  Presenting work as independent work when it has been produced in whole or part in collusion with other people. Collusion includes,
  
  - students providing their work to another student before the due date, or for the purpose of them plagiarising at any time
  - paying another person to perform an academic task and passing it off as your own
  - stealing or acquiring another person’s academic work and copying it
  - offering to complete another person’s work or seeking payment for completing academic work.
  
  This should not be confused with academic collaboration.

- **Inappropriate citation**
  
  Citing sources which have not been read, without acknowledging the 'secondary' source from which knowledge of them has been obtained.

- **Self-plagiarism**
  
  ‘Self-plagiarism’ occurs where an author republishes their own previously written work and presents it as new findings without referencing the earlier work, either in its entirety or partially.
  
  Self-plagiarism is also referred to as 'recycling', 'duplication', or 'multiple submissions of research findings' without disclosure. In the student context, self-plagiarism includes re-using parts of, or all of, a body of work that has already been submitted for assessment without proper citation.

The Learning Centre also provides substantial educational written materials, workshops, and tutorials to aid students, for example, in:
Individual assistance is available on request from The Learning Centre.

Students are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting, and the proper referencing of sources in preparing all assessment items.

Continual Course Improvement

- At the end of the course, students will be asked to provide evaluative feedback through myExperience, the University’s course and teaching evaluation and improvement process
- Students are encouraged to address any problems regarding teaching of this course at the annual staff-student meeting
- Student comments on teaching during the session are welcome and will be appreciated
- At times students may be asked to answer a short questionnaire for feedback on the course

Administrative Matters

- Students should attend at least 80% of all classes.
- Students unable to submit assignments on time or attend the mid-session quizzes or final exams on health grounds should make a request for special consideration. 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/lab reports submitted after the due date for submission will receive a 10% of maximum grade penalty for every day late, or part thereof.
- 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 for Exams

Rules governing conduct during exams are given at: https://student.unsw.edu.au/exam-rules