

MIE1705HS Thermoplastics Polymer Processing Syllabus

Course Outline

Instructor

Prof. Patrick C. Lee
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Office Hours

By email

Teaching Assistants

Nathan Chang
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Course Schedule

- Lectures
Thursdays
Hours: 13:00-16:00

BA2159

Contact Hours

- 0.5 credits
- Lectures:
2 hrs x 16 wks/term = 32 hrs

Prerequisites

N/A

Course Website

Quercus Portal

Important Dates

Final Report & Presentation
April 4th, 2024

Course Description

This course is designed to provide the background for an understanding of the wide field of polymer processing, and provide a strong foundation including fundamentals and applications of polymer processing. Topics include: fundamentals of polymers, rheology, extrusion, coextrusion, injection molding, die flow and other common plastics processes such as fiber spinning, blow molding, rotational molding, coating, etc. if time allows.

Textbook

Understanding Rheology and Technology of Polymer Extrusion, 1st Ed. J. Vlachopoulos and Nickolas D. Polychronopoulos

These textbooks are for references only.

- Extrusion of Polymers: Theory and Practice, C. I. Chung, Hanser (2010).
- Understanding Polymer Processing: Processes and Governing Equations, T. Ossward, Hanser (2010).
- Principles of Polymer Processing, 2nd ed. Z. Tadmor and C. G. Gogos, Wiley, NY (2006).
- Rheology: Principles, Measurements, and Applications, C. W. Macosko, VCH, New York, NY, (1994).
- Melt Rheology and Its Role in Plastics Processing: Theory and Applications, J. M. Dealy and K. F. Wissbrun, Springer (1999).
- Manufacturing Processes for Engineering Materials (6th Edition), by Serop Kalpakjian and Steven Schmid, Prentice Hall (2017).
- Polymer Processing: Principles and Design, D. G. Baird and D. I. Collias, Wiley, NY (2014).

Requirements/Regulations

<https://engineering.calendar.utoronto.ca/academic-regulations>

List of Topics

- **Introduction**
 - Course outline & Introduction;
 - Current and future trends of polymer processing technologies;
- **Polymeric Materials**
 - Introduction to polymers;
 - Mechanical behavior of polymers;

- Melt rheology;
- **Extrusion**
 - Solid conveying;
 - Melting;
 - Metering;
 - Screw types and design;
- **Coextrusion**
 - Viscosity ratio;
 - Multiphase flows;
 - Interfacial slips;
- **Injection Molding**
 - Injection molding cycle;
 - Injection molding machine;
 - Special injection molding processes;
- **Die Forming**
 - Capillary flow;
 - Sheet forming and film casting;
 - Tube and blown film;
 - Die types and design;
- **Mixing**
 - Distributive mixing;
 - Dispersive mixing;
 - Mixing devices;
- **Other Plastics Processes (Optional Topics)**
 - Fiber spinning;
 - Blow molding;
 - Thermoforming;
 - Coating;
 - Rotational molding

Learning Objectives

At the end of the course, students should be able to:

- Develop potential application-driven solutions to real-life polymer processing problems with targeted quantitative estimation
- Recommend potential improvements over currently available polymer processing technologies and platforms
- Understand the key practical theory with the operation principles of polymer processing technologies and their potential limitations

- Select and justify appropriate processing technologies for specific applications

Evaluation

- Journal Article Reviews/Discussions & Assignments (35%)
- Project Reports and Presentations (40%)
- Final examination (25%)
- Total: 100 %

Academic Integrity

Students are expected to conduct themselves in accordance with the highest ethical standards of the Profession of Engineering and evince academic integrity in all their pursuits and activities at the university. As such, in accordance with the General Academic Regulations on Academic Integrity, students are reminded that plagiarism or any other form of cheating in examinations, term tests, assignments, projects, or laboratory reports is subject to serious academic penalty (e.g. suspension or expulsion from the faculty or university). A student found guilty of contributing to cheating by another student is also subject to serious academic penalty. Normally, students will be required to submit their course essays to Turnitin.com for a review of textual similarity and detection of possible plagiarism. In doing so, students will allow their essays to be included as source documents in the Turnitin.com reference database, where they will be used solely for the purpose of detecting plagiarism. The terms that apply to the University's use of the Turnitin.com service are described on the Turnitin.com web site.

Inclusivity Statement

You belong here. The University of Toronto commits to all students, faculty and staff that you can learn, work and create in a welcoming, respectful and inclusive environment. In this class, we embrace the broadest range of people and encourage their diverse perspectives. This team environment is how we will innovate and improve our collective academic success. You can read the evidence for this approach here.

We expect each of us to take responsibility for the impact that our language, actions and interactions have on others. Engineering denounces discrimination, harassment and unwelcoming behaviour in all its forms. You have rights under the Ontario Human Rights Code. If you experience or witness any form of harassment or discrimination, including but not limited to, acts of racism, sexism, Islamophobia, anti-Semitism, homophobia, transphobia, ableism and ageism, please tell someone so we can intervene. Engineering takes these reports extremely seriously. You can talk to anyone you feel comfortable approaching, including your professor or TA, an academic advisor, our Assistant Dean, Diversity, Inclusion and Professionalism, the Engineering Equity Diversity & Inclusion Action Group, any staff member or a U of T Equity Office.

You are not alone. Here you can find a list of clubs and groups that support people who identify in many diverse ways. Working together, we can all achieve our full potential.

Statement on Accommodations

The University of Toronto supports accommodations for students with diverse learning needs, which may be associated with mental health conditions, learning disabilities, autism spectrum, ADHD, mobility impairments, functional/fine motor impairments, concussion or head injury, blindness and low vision, chronic health conditions, addictions, deafness and hearing loss, communication disorders and/or temporary disabilities, such as fractures and severe sprains, or recovery from an operation.

If you have a learning need requiring an accommodation the University of Toronto recommends that students register as soon as possible with Accessibility Services.

Phone: **416-978-8060**

Email: accessibility.services@utoronto.ca

Statement on Mental Health

As a university student, you may experience a range of health and/or mental health challenges that could result in significant barriers to achieving your personal and academic goals. Please note, the University of Toronto and the Faculty of Applied Science & Engineering offer a wide range of free and confidential services that could assist you during these times.

As a U of T Engineering student, you have an Academic Advisor (undergraduate students) or a Graduate Administrator (graduate students) who can support you by advising on personal matters that impact your academics. Other resources that you may find helpful are listed on the U of T Engineering Mental Health & Wellness webpage, and a small selection are also included here:

- [Accessibility Services & the On-Location Advisor](#)
- [Graduate Engineering Council of Students' Mental Wellness Commission](#)
- [Health & Wellness](#) and the [On-Location Health & Wellness Engineering Counsellor](#)
- [Inclusion & Transition Advisor](#)
- [U of T Engineering Learning Strategist](#) and [Academic Success](#)
- [My Student Support Program \(MySSP\)](#)
- [Registrar's Office](#)
- [SKULE Mental Wellness](#)
- [Scholarships & Financial Aid Office & Advisor](#)

If you find yourself feeling distressed and in need of more immediate support resources, consider reaching out to the counsellors at [My Student Support Program \(MySSP\)](#) or visiting the [Feeling Distressed webpage](#).

Land Acknowledgement

The University of Toronto operates on land that for thousands of years has been the traditional land of the Huron-Wendat, the Seneca, and most recently, the Mississauga of the Credit River. Today, this meeting place is still the home to many Indigenous people from across Turtle Island and we are grateful to have the opportunity to work on this land.