MSE6600 Advanced Polymer Processing, Fall 2020

Catalogue Data: Overview of common polymer processing techniques and recent advancement; Modeling of polymer processing with emphasis on how a sound model can be built; Computer aided engineering for polymer processing.
Text: No designated textbook. Course notes will be provided.

Pre-requisite knowledge: Tensor calculus, some understanding of rheology and continuum mechanics

References:
- Z. Tadmor and C.G. Gogos, *Principles of Polymer Processing*, Wiley-Interscience, 2006.
- J.F. Agassant, P. Avenas, J.-P. Sergent and P.J. Carreau, *Polymer Processing: Principles and Modeling*, Hanser, New York, 1991.
- J. A. Dantzig and C. L. Tucker, *Modeling in Materials Processing*, Cambridge University Press, Cambridge, UK, 2001.
- D.G. Baird and D.T. Collias, *Polymer Processing Principles and Design*, Wiey, John & Sons, 1998.
- A.I. Isayev, ed., *Injection and Compression Molding Fundamentals*, Marcel Dekker, Inc., New York, 1987.
- C.L. Tucker, ed., *Fundamentals of Computer Modeling for Polymer Processing*, Hanser Publishers, Munich, 1990.
- R.I. Tanner, *Engineering Rheology*, Second Edition, Oxford University Press, 2000.
- C.W. Macosko, *Rheology: Principles, Measurements, and Applications*, VCH, New York, NY, 1994.
- S. Middleman, *Fundamentals of Polymer Processing*, McGraw-Hill, 1977.
- Assorted papers including
  - Y. Jaluriz, "Fluid flow phenomena in materials processing – the 2000 Freeman scholar lecture", *Journal of Fluids Engineering*, Vol. 125, pp. 173-210 (2001).

Instructor: Donggang Yao, Room 4407 MRDC-I
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BlueJeans link: https://gatech.bluejeans.com/673703960

Logistics:
- This is a residential course. All lectures will be conducted in LOV 185 at the officially scheduled class meeting time.
- Lectures will be recorded and posted on Canvas after class. However, student participation from the remote end is disabled during lecture. Students who did not attend the lecture can only view the recorded lectures.
- Backup plan: If the instructor got sick or quarantined, efforts would be made to find a replacing instructor to continue the class in the residential mode. If this could not be done, the class would be converted into an online class (maybe taught by the same instructor or by a substitute instructor).
- For purposes of contact tracing, it is recommended by the university to take attendance and track it with seating arrangement.
- It is anticipated that a student will physically attend at least 80% of all lectures. In the final grade calculation, course engagement accounts for 10%. Evidences of course engagement include but are not limited to attending lectures, participating in classroom discussion, participating in the office time sessions, and participating in out-of-classroom discussion (via Canvas).
- The midterm exam will be given in class during the scheduled class meeting time. You will bring with you blank papers to write your answers to the exam questions. A laptop with a camera (or an

equivalent digital device) is needed to take pictures of your exam and submit to Canvas at end of the exam. The exam problems/questions will be projected to the screen in the classroom during the exam.

- Final exam will be conducted using Canvas. It will be given during the final exam period at the time assigned to this section. We will allow additional 15 minutes each before and after the exam to allow student to have extra time to print (if preferred) and submit the exam.
- For a student who have requested accommodations through the Office of Disability Services, he/she needs to contact the instructor by sending the instructor an email and the approved accommodation letter so that appropriate measures will be put into place accordingly.

Course Objectives:

By the end of the course, the successful student will be able to:

1. Describe common polymer processing techniques and recent advancement in polymer processing
2. Understand the general framework for building a sound model for polymer processing
3. Employ the Hele-Shaw flow model to analyze injection molding and compression molding
4. Analyze the free surface flow in extrusion and post extrusion processes
5. Analytically or numerically solve polymer flow and heat transfer problems
6. Simulate polymer processing problems using computer aided engineering

Topical Outline:

1. Logic for polymer processing
2. Review on continuum mechanics and polymer melt rheology
3. Deformation of a polymer coil
4. How to build a sound model for polymer processing?
5. Dimensional, order-of-magnitude and scaling analyses
6. Numerical methods for polymer processing
7. Modeling of die flow
8. Modeling of molding processes
9. Modeling of elongational flow in polymer processing
10. Modeling of viscoelastic flow and hyperelastic deformation

Homework/Assignment/Exam Policy:

Homework will be assigned biweekly and should be handed in at the beginning of the due class. Homework is expected to be independently completed by an individual student. Clarifications on homework/assignments will be provided during class hours, when requested. *Late submission of homework/assignments/reports will not be accepted*. Unless the instructor is informed early with a valid reason, missed exams cannot be made up. Efforts will be made to accommodate students with disabilities or other special needs. The instructor expects to be alerted to special needs at the beginning of the semester.

Grading:

Components	Percentage
Quizzes, attendance, etc.	10%
Homework	25%
Midterm exam	25%
Final exam (cumulative)	40%