# MSE6600 Advanced Polymer Processing

**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.

**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:**

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**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 and quizzes 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% |