

ME473/673 - Engineering with Polymeric Materials (Fall 2023)

Syllabus

- Instructor:** Dr. Long Jiang, Dolve 207
Phone: 1-9512, Email: long.jiang@ndsu.edu
- Office hours:** Tuesday 2:00-3:00 PM or by appointment.
- Lecture:** Tuesday/Thursday, 3:30-4:45 PM, Dolve 202
- Required Text:** Plastics: Materials and Processing (1st or 3rd Edition), by A. Brent Strong, Pearson, 2005
- Suggested Text:** Introduction to Polymer Viscoelasticity, 3rd ed., Montgomery T. Shaw, William J. MacKnight, John Wiley & Sons, 2005
Physical Properties of Polymers, 3rd ed., J. Mark, K. Ngai, W. Graessley, L. Mandelkern, E. Samulski, J. Koenig, & G. Wignall, Cambridge Univ. Press, 2004
- Pre-requisites:** ME331 and admission to professional program
- Course Description:** This course will introduce basic polymer materials including plastics, rubbers, fibers; structures, properties, and relationships of polymers; additives; processing technologies, applications and development.

Topics Covered and Tentative Schedule:

1. Introduction to the course and polymers
2. Structures of thermoplastic, thermoset, & elastomeric polymers: bonding & the forces between chains, conformations, linear chains, branching, cross-linking and network formation; copolymers and blends; molecular weight; polymer synthesis; crystallization; effect of polymer structures

Midterm Exam

3. Mechanical behavior of thermoplastic, thermoset, & elastomeric polymers: strength, modulus and toughness; yield and fracture; viscoelasticity; rubber elasticity
4. Rheology and processing methods: principles of rheology; processing methods of extrusion, injection molding, blow molding, thermoforming, rotational molding, casting, foaming, compression molding
5. Design with polymers
6. Environmental aspects of polymers
7. Biobased polymers/biodegradable polymers

Grading/Evaluation Criteria:

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Homework (including reports):	30%	25%
In- and Out-of-Class Exercises:	25%	25%
Midterm Exam:	20%	20%
Comprehensive Final Exam:	25%	20%
Term Project:	N.A.	10%

Contract Grades:	≥90%	A
	≥80%	B
	≥70%	C
	≥60%	D
	<60%	F

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Course Outcomes and Relationship to Program Outcomes:

No.	Course Outcome	Affected Student Outcomes
1.	Students should be familiar with the common terms used to describe engineering plastics such as thermoplastics and thermosets, molecular weight, processing, and common applications of well-known plastics.	6, 4,
2.	Students should develop an elementary understanding of the operation and scientific principles in plastics processing and processing equipment including extrusion and injection molding.	6, 7
3.	Students should develop the basic understanding of the microstructures of polymeric materials including thermoplastics, semicrystalline and amorphous polymers, natural and synthetic elastomers, and thermosets.	1, 6
4.	Students should develop an understanding of the deformation of polymers including concepts of yielding, necking, true stress, and true strain.	1
5.	Students should be able to apply linear viscoelasticity theory and time-temperature superposition to characterization of plastics.	1
6.	Students should be familiar with the elementary concepts and applications of fracture mechanics in engineering plastics in design problems.	1
7.	Students should be familiar with the thermal analytical techniques including TGA, DSC and DMA in characterization of engineering plastics.	6, 7
8.	Students must be able to apply concepts learned in the course to the design of engineering plastics.	3, 4, 5, 7

Affected Student Outcomes:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

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Course Policies:

- According to NDSU Policy 333 (<http://www.ndsu.nodak.edu/policy/333.htm>), attendance in class (in person or remotely) is expected. Only the course instructor can excuse a student from course responsibilities (the term “course” includes class, laboratory, field trips, group exercises, and/or other activities).
- Late homework or out-of-class exercises: 25% penalty (1 day late), 50% penalty (2 days late), and no credit (after solutions are posted). All homework due dates will be announced in class one week prior.
- Students are responsible for the materials that are covered in the class. It is expected that students will have read the assigned chapter or chapter sections prior to the lecture.
- No makeup for missed quizzes or in-class exercises. If you must miss a quiz or in-class exercise because of serious illness, family death, etc., notify the instructor or the ME department office (231-8671) as soon as possible and a makeup assignment will be arranged.
- All examination attendance is mandatory. If you must miss an examination because of serious illness, family death, etc., notify the instructor or the ME department office (231-8671) as soon as possible and makeup arrangements will be made on a case by case basis. Excuses of a non-urgent nature will not be accepted and failure to attend an examination will result in an F for the course.
- A Blackboard site will be maintained for the course and will include posting of all communications, homework assignments, all documents handed out during lecture, all lecture PowerPoint and overhead slides, any course announcements, and individual grades as time permits. All assignments/quizzes/exams will be conducted on Blackboard.
- The instructor holds the right to amend the course schedule during the semester if needed.

Health and Safety Expectations

While masks are not required as we begin the 2022 fall semester, NDSU administration has determined that faculty may request mask use in their classroom. Where possible, please spread out within the classroom, including not sitting in the first row of the classroom, to maximize social distancing.

Attendance Statement:

- According to [NDSU Policy 333 \(www.ndsu.edu/fileadmin/policy/333.pdf\)](http://www.ndsu.edu/fileadmin/policy/333.pdf), attendance in classes is expected.
- Veterans and student service members with special circumstances or who are activated are encouraged to notify the instructor as soon as possible and are encouraged to provide Activation Orders.

Americans With Disabilities Act for Students with Special Needs:

Any students with disabilities or other special needs, who need special accommodations in this course, are invited to share these concerns or requests with the instructor and contact the Disability Services Office (www.ndsu.edu/disabilityservices) as soon as possible.

Academic Honesty Statement:

The academic community is operated on the basis of honesty, integrity, and fair play. [NDSU Policy 335: Code of Academic Responsibility and Conduct](#) applies to cases in which cheating, plagiarism, or other academic misconduct have occurred in an instructional context. Students found guilty of academic misconduct are subject to penalties, up to and possibly including suspension and/or expulsion. Student academic misconduct records are maintained by the [Office of Registration and Records](#). Informational resources about academic honesty for students and instructional staff members can be found at

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www.ndsu.edu/academichonesty.

Additional Resources for Students:

Students are encouraged to use support resources

- As a member of the NDSU community, resources are available for you should you need help in dealing with adverse reactions to things happening in the world today. A variety of resources are listed below:

For students on campus and remotely (telehealth):

Counseling Services: 701-231-7671; <https://www.ndsu.edu/counseling/>

Disability Services: 701-231-8463; <https://www.ndsu.edu/disabilityservices/>

Student Health Service: 701-231-7331; <https://www.ndsu.edu/studenthealthservice/>

Dean of Students Office: 701-231-7701; <https://www.ndsu.edu/deanofstudents/>

In a crisis or emergency situation:

Call University Police: 701-231-8998

Call 9-1-1

Go to a Hospital Emergency Room

Go to Prairie St. Johns for a Needs Assessment: 701-476-7216 (510 4th St. S.)

Call the FirstLink Help Line: 1-800-273- TALK (8255) or 2-1-1

Call Rape and Abuse Crisis Center: 701-293-7273