POLYMER TECHNOLOGY AND ENGINEERING

MSE 455/555         Spring 2016

Instructor: Dr. C. M. Balik (balik@ncsu.edu, EB1 room 3078C)  
Lectures: 8:30 - 9:45 T-Th  
Office hours: by appointment  
EB1 Room 3003  
TA: TBA  
Credit hours: 3(3-0)

Office hours: TBA

Prerequisite: MSE 380 or equivalent. If you haven't passed this course, please see the instructor.

Required text: Principles of Polymer Engineering, 2nd ed.; McCrum, Buckley and Bucknall, Oxford Press, 1997 (approx. $70 on Amazon)

For reference only:
Introduction to Polymers, 3rd ed.; R.J. Young and P.J. Lovell. (CRC Press, 2011). This is the MSE 380 textbook.

OVERVIEW
This is a dual level course which may be taken at the undergraduate (MSE 455) or the graduate level (MSE 555). It covers selected topics in rubber elasticity, viscoelasticity, time-temperature superposition, Boltzmann superposition, ultimate properties of polymers, polymer rheology, polymer processing, commercial polymers, and design and selection of polymeric materials.

LEARNING OUTCOMES
By the end of this course, students will be able to:
• Describe the mechanical behavior of rubber using the thermodynamic theory of rubber elasticity
• Derive equations for and interpret the behavior of spring-dashpot models for polymer viscoelasticity
• Analyze DMA data to select polymers based on their stiffness
• Explain the connection between time and temperature and their effects on polymer properties
• Describe the effects of plastic deformation on polymer morphology
• Describe and explain injection molding, extrusion and other processing methods for producing plastic parts
• Identify the various classes of polymers based on their properties and applications

WEB RESOURCES
A Moodle course locker will be maintained for this course which contains copies of the instructor’s notes, course syllabus, course schedule, homework sets, homework solutions, and other course material. Files are posted in PDF format.

EXAMINATIONS
Four equally-weighted exams will be administered. The final exam (Exam 4) will not be comprehensive. Proposed exam dates are shown on the schedule and are repeated here. Exam dates may change depending on the rate at which the class progresses.

Exam 1  January 28
Exam 2  March 1
Exam 3  March 31
Exam 4  May 3, 8:00 - 11:00 am

Students are expected to take the exams on the specified dates. Make-up exams will be administered only under extenuating circumstances. Occurrence of other exams on or near the above dates is not a valid excuse for missing exams. Students anticipating an absence during a scheduled exam date for a valid reason must discuss it in advance with the instructor.

MSE 455 HOMEWORK PROBLEMS
Homework problems will be assigned and collected regularly. Experience has shown that completion of homework problems contributes significantly to good performance on exams. MSE 455 homework problems will not be checked for correctness,
but for completeness only. Each homework problem will be awarded from 0 to 2 points as follows:

- **2 points:** all parts of the problem complete; answers obtained for all parts
- **1 point:** problem not done but at least half complete; reasonable attempt made to solve the problem
- **0 points:** problem not attempted or less than half complete

In the final course grade, the cumulative homework grade will receive the same weight as one exam. Due dates for homework problems are listed on the course schedule. *Completed homework should be placed in the MSE 455/555 box outside the instructor’s office (EB1 3078C) by 4 pm on the due date.* After a homework set is collected, solutions will be posted in the course locker.

**MSE 555 SUPPLEMENTARY HOMEWORK PROBLEMS**

In addition to completing the homework and all other requirements for MSE 455, students enrolled in MSE 555 will also be required to complete additional, more advanced homework problems. These will be graded for correctness and the cumulative grade on these supplementary homework problems will be weighted as 10% of the final course grade.

**PLANT TRIPS**

Two plant trips will be planned for April. Exact dates will be announced after confirmation with the sponsoring companies. The plant trips will provide a first-hand look at polymer injection molding and extrusion processes. Each student will be required to write a report describing each trip. The combined plant trip report grades will count as one exam. Distance ed students are encouraged to participate in the plant trips if they can, but are not required to do so. Distance ed students who do not participate in the plant trips will be required to write two term papers instead of the trip reports.

**GRADING**

**MSE 455:** The final course grade will be based on the four exams (18% each), the cumulative homework grade (18%) and the combined field trip report grade (10%).

**MSE 555:** The final course grade will be based on the four exams (16% each), the cumulative homework grade (16%), the combined field trip report or term paper grade (10%) and the cumulative grade on the extra homework problems (10%).

The minimum final course grades will be based on the following scale:

<table>
<thead>
<tr>
<th>Grade</th>
<th>MSE 455</th>
<th>MSE 555</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+</td>
<td>97.0-100</td>
<td>97.0-100</td>
</tr>
<tr>
<td>A</td>
<td>92.0-96.9</td>
<td>96.0-100</td>
</tr>
<tr>
<td>B+</td>
<td>88.0-89.9</td>
<td>88.0-90.9</td>
</tr>
<tr>
<td>B</td>
<td>82.0-87.9</td>
<td>82.0-92.9</td>
</tr>
<tr>
<td>C+</td>
<td>78.0-79.9</td>
<td>78.0-97.9</td>
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<tr>
<td>C</td>
<td>72.0-77.9</td>
<td>72.0-99.9</td>
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<tr>
<td>D+</td>
<td>68.0-69.9</td>
<td>65.0-99.9</td>
</tr>
<tr>
<td>D</td>
<td>62.0-67.9</td>
<td>62.0-99.9</td>
</tr>
<tr>
<td>F</td>
<td>0-59.9</td>
<td>0-59.9</td>
</tr>
</tbody>
</table>

**Requirements for credit-only grading (S/U)**

In order to receive a grade of S, students are required to complete all exams and assignments and earn a grade of C- or better. Conversion from letter grading to credit only (S/U) grading is subject to university deadlines. Refer to the Registration and Records calendar for deadlines related to grading. For more details refer to:

[http://policies.ncsu.edu/regulation/reg-02-20-15](http://policies.ncsu.edu/regulation/reg-02-20-15)

**Requirements for audit grading (AU)**

In order to receive a grade of AU, students must attend class and complete all homework assignments. For more details refer to

[http://policies.ncsu.edu/regulation/reg-02-20-04](http://policies.ncsu.edu/regulation/reg-02-20-04)

**Incomplete grades (IN)**

Incomplete grades will be given only under extenuating circumstances, in accordance with NCSU policy as described at the website below. If an extended deadline is not authorized by the instructor or department, an unfinished incomplete grade will automatically change to an F after either (a) the end of the next regular semester in which the student is enrolled (not including summer sessions), or (b) by the end of 12 months if the student is not enrolled, whichever is shorter. Incompletes that change to F will count as an attempted course on transcripts. The burden of fulfilling an incomplete grade is the responsibility of the student.

[http://policies.ncsu.edu/regulation/reg-02-50-3](http://policies.ncsu.edu/regulation/reg-02-50-3)
INSTRUCTOR'S CLASS NOTES ONLINE: DISCLAIMER
A copy of the instructor’s class notes will be placed in the course locker. These notes are written primarily for use by the instructor, not the student, and therefore should not be considered as a substitute for the textbook or as an alternative to attending class and taking your own notes. These notes are provided as a courtesy to the student and are not guaranteed to contain everything students need to know for each exam, however, they do provide a detailed outline of the major topics covered for each exam.

ATTENDANCE
Students are expected to attend all classes. If there is a need to miss a class, notify the instructor in advance. It is the student’s responsibility to obtain any information from missed classes. For NCSU attendance regulations, refer to the academic policy and regulations website at:

http://policies.ncsu.edu/regulation/reg-02-20-03

ACADEMIC INTEGRITY
As a student enrolled in this class, you are expected to honor the NCSU policies regarding academic integrity found in the Code of Student Conduct at http://policies.ncsu.edu/policy/pol-11-35-01.

See http://policies.ncsu.edu/policy/pol-11-35-01 for a detailed explanation of academic honesty.

If there are questions regarding any matter relating to the standards of academic integrity in this course or on a given assignment, they should be discussed with the instructor prior to doing any work. If any violation of the academic integrity policies is observed, please notify the instructor immediately. Once a violation has occurred, the case will be pursued through procedures outlined by the University.

STUDENTS WITH DISABILITIES
Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with Disability Services Office (http://www.ncsu.edu/dso/, 919-515-7653) located at 1900 Student Health Center, Campus Box 7509, 515-7653. Students with disabilities should contact the instructor for any additional assistance. Federal law mandates that the faculty provide reasonable accommodations to students with disabilities. For more information on NC State's policy on working with students with disabilities, please see the Academic Accommodations for Students with Disabilities Regulation at

http://policies.ncsu.edu/regulation/reg-02-20-01

ANTI-DISCRIMINATION STATEMENT
NC State University provides equality of opportunity in education and employment for all students and employees. Accordingly, NC State affirms its commitment to maintain a work environment for all employees and an academic environment for all students that is free from all forms of discrimination. Discrimination based on race, color, religion, creed, sex, national origin, age, disability, veteran status, or sexual orientation is a violation of state and federal law and/or NC State University policy and will not be tolerated. Harassment of any person (either in the form of quid pro quo or creation of a hostile environment) based on race, color, religion, creed, sex, national origin, age, disability, veteran status, or sexual orientation also is a violation of state and federal law and/or NC State University policy and will not be tolerated. Retaliation against any person who complains about discrimination is also prohibited. NC State's policies and regulations covering discrimination, harassment, and retaliation may be accessed at http://policies.ncsu.edu/policy/pol-04-25-05 or http://www.ncsu.edu/equal_op/. Any person who feels that he or she has been the subject of prohibited discrimination, harassment, or retaliation should contact the Office for Equal Opportunity (OEO) at 919-515-3148.

ONLINE COURSE EVALUATIONS
Online class evaluations will be available for students to complete during the last two weeks of class. Students will receive an email message directing them to a website where they can login using their Unity ID and complete evaluations. All evaluations are confidential; instructors will never know how any one student responded to any question, and students will never know the ratings for any particular instructors. More information about course evaluations can be found at

http://www2.acs.ncsu.edu/UPA/classeval/index.htm