

## **Polymer Physical Science**

EMA6165, Sections 2E52

**Class Periods:** Tue, 9:35 – 10:25 AM, Tue/Thur, 10:40 – 11:30 AM

**Location:** CISE E-122

**Academic Term:** Fall 2017

### **Instructor:**

Anthony B. Brennan, PhD

[abrennan@mse.ufl.edu](mailto:abrennan@mse.ufl.edu)

352-392-6281 (O) 352-219-8165 (C)

Office Hours: Days of week, hours available, office location

### **Teaching Assistants:**

Please contact through the Canvas website: <https://ufl.instructure.com/courses/339208t>

- Dr. Sheema Freeman, [sfreeman@mse.ufl.edu](mailto:sfreeman@mse.ufl.edu)
- Mr. Clayton Argenbright, [cargenbright@ufl.edu](mailto:cargenbright@ufl.edu), 305 MAE, Office Hours to be announced

### **Course Description**

Solid state properties of amorphous and semi-crystalline polymers.

### **Course Pre-Requisites / Co-Requisites**

EMA 3066

### **Course Objectives**

- Students will be able to:
  - Apply first order thermodynamics to describe molecular dimensions of polymers/plastics
  - Correlate physical and mechanical properties with thermodynamic properties of polymers/plastics
  - Correlate morphology with physical, mechanical and thermal properties of polymers/plastics
  - Correlate rubber elastic behavior with molecular structure, composition and network structure of polymers/plastics
  - Conduct experiments to observe the physical, mechanical and thermal properties of polymers

### **Materials and Supply Fees**

NA

### **Required Textbooks and Software**

- Title: Introduction to Physical Polymer Science
- Author: L.H. Sperling
- Publisher: John Wiley & Sons
- Published: 2006, 4<sup>th</sup> Edition
- ISBN: 978-0471706069
- Lecture notes/slides provided on:
  - Website: Canvas: EMA 4161/EMA4161L { <https://ufl.instructure.com/courses/339208> }

### **Recommended Materials**

- Additional materials provided on Website: Canvas: EMA 4161/EMA4161L
- Other materials: <https://ufl.instructure.com/courses/339208>
  - [Previous exams](#)
  - [Guide to Thermal Properties of Polymers](#)
  - [Equations Used in Polymer Physics](#)

### **Course Schedule**

See attachment to this Syllabus

### ***Attendance Policy, Class Expectations, and Make-Up Policy***

Attendance is required to complete the lab assignments. Arrival on time is expected. Please turn off all cell phones upon entering class. Reading of newspapers, work on assignments for this or other classes, or other activities that are not part of the class are not allowed. Students who do not comply with these requirements or who behave disorderly or disrespectfully may be asked to leave the classroom. Make up labs will be provided only with the **approval of the instructor in accordance with university policies**. Excused absences are consistent with university policies in the undergraduate catalog (<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>) and require appropriate documentation. In general, acceptable reasons for excused absence include illness, serious family emergencies, special curricular requirements, military obligation, court-imposed legal obligations, and religious holidays. In all cases, you will be required to provide written documentation, and obtain instructor approval. You will not be excused from any lab without following the policy above, with no exceptions. Students not in attendance for the scheduled lab will receive a score of zero.

### ***Evaluation of Grades***

<b>Assignment</b>	<b>Total Points</b>	<b>Percentage of Final Grade</b>
Homework Sets (10)	10 each	6%
Quizzes (4)	25 each	10%
Exam 1	100	21%
Exam 2	100	21%
Exam 3	100	21%
Project*	100	21%
		100%

\*Refer to Proposal Outline Attachment

### ***Grading Policy***

<b>Percent</b>	<b>Grade</b>	<b>Grade Points</b>
93.1 - 100	A	4.00
89.8 - 93.0	A-	3.67
86.5 - 89.7	B+	3.33
83.2 - 86.4	B	3.00
79.9 - 83.1	B-	2.67
76.6 - 79.8	C+	2.33
73.3 - 76.5	C	2.00
70.0 - 73.2	C-	1.67
66.7 - 69.9	D+	1.33
63.4 - 66.6	D	1.00
60.0 - 63.3	D-	0.67
0 - 59.9	E	0.00

More information on UF grading policy may be found at:  
<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

### ***Students Requiring Accommodations***

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

### ***Course Evaluation***

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu/evals>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results/>.

### ***University Honesty Policy***

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

### ***Software Use***

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

### ***Student Privacy***

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html>

## ***Campus Resources:***

### ***Health and Wellness***

#### **U Matter, We Care:**

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu) so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

**Counseling and Wellness Center:** <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

#### **Sexual Assault Recovery Services (SARS)**

Student Health Care Center, 392-1161.

**University Police Department** at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

### ***Academic Resources***

**E-learning technical support**, 352-392-4357 (select option 2) or e-mail to [Learning-support@ufl.edu](mailto:Learning-support@ufl.edu).  
<https://lss.at.ufl.edu/help.shtml>.

**Career Resource Center**, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

**Library Support**, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

**Teaching Center**, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.  
<https://teachingcenter.ufl.edu/>.

**Writing Studio, 302 Tigert Hall**, 846-1138. Help brainstorming, formatting, and writing papers.  
<https://writing.ufl.edu/writing-studio/>.

**Student Complaints Campus:** [https://www.dso.ufl.edu/documents/UF\\_Complaints\\_policy.pdf](https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf).

**On-Line Students Complaints:** <http://www.distance.ufl.edu/student-complaint-process>.

**EMA6165, Sections 2E52**  
**Polymer Physical Science**  
**Tue (T) Period 3 (9:35 – 10:25 AM) E122 CISE**  
**Tue (T) Period 4 (10:40 – 11:30 AM) E122 CISE**  
**Thu (R) Period 4 (9:35 – 10:25 AM) E122 CISE**  
**3 CREDITS**

**Instructor:** Dr. A.B. Brennan  
**Office:** 309 MAE  
**Telephone:** 352.392.6281 (o)  
352.219.8165 (m)  
**Email:** abrennan@mse.ufl.edu  
**Office hours:** Tue Period 3 Thur Period 4: and By Appointments  
**Website:** brennan.mse.ufl.edu

*HONOR CODE: We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity.*

## **COMPREHENSIVE FINAL EXAM**

**Monday, December 11**

**7:30 AM to 9:30 AM**

**Group 11E**

This schedule is meant to identify the materials and times for the semester. However, there will be variations due to unforeseen circumstances. The actual lectures will be given at other times if the schedule is changed. The materials covered may vary depending upon student needs and abilities.

*"Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation."*

No.	Date	Day	Topic	Assignment
1.	8/22/17	Tue	Introduction	Read Chapter 1 (Before class) Hmwk 1: #1.2, #1.5, #1.8, #1.9
2.	8/22/17	Tue	Fundamentals, Nomenclature, cont'd	
3.	8/24/17	Thu	Condensation and Addition Polymerizations, Polymers	
4.	8/24/17*	Thu	Chain configuration, conformations (Make-up for 8/29/17)	Read Chapter 2 Hmwk 2: #2.1, #2.2, #2.4, #2.7
	8/29/17*	Tue	<i>Make-up scheduled for 8/24/17 Period 5</i>	
	8/29/17*	Tue	Make-up scheduled for 9/7/17 Period 5	<b>Hmwk 1: DUE</b>
	8/31/17	Thu	Make-up scheduled for 9/14/17 Period 5	
5.	9/5/17	Tue	Dilute solution Thermodynamics - Entropy	Read Chapter 3, Hmwk 3: #3.1, #3.2, #3.4, #3.7
6.	9/5/17	Tue	Chain Statistics - Random Flight Gel Permeation Chromatography	<b>QUIZ 1:</b>
7.	9/7/17	Thu	<i>Gel Permeation Chromatography</i>	<b>Hmwk 2: DUE</b>
8.	9/7/17*	Thu	Polymer-polymer miscibility (Make-up for 8/29/17)	Read Chapter 4: Hmwk 4: #4.1, #4.2, #4.4, #4.7
9.	9/12/17	Tue	P(S-b-BD-S) Morphology	
10.	9/12/17	Tue	Polymer-polymer miscibility (Make-up for 8/29/17)	
11.	9/14/17	Thu	Polymer-polymer miscibility (Make-up for 8/29/17)	<b>Hmwk 3: DUE</b>
12.	9/14/17*	Thu	Amorphous State – Experimental Methods	Read Chapter 5 Hmwk 5: 5.2, 5.5, 5.7 and 5.9
13.	9/19/17	Tue	<i>Amorphous State-Chain dimensions</i>	<b>QUIZ 2:</b>
14.	9/19/17	Tue	Amorphous State-Reptation	
15.	9/21/17	Thu	Crystalline Structure – Lattices, T <sub>m</sub>	<b>Hmwk 4: Due</b> (Assignment 4)
16.	9/26/17	Tue	<b>EXAM 1</b>	
17.	9/26/17	Tue	<b>EXAM 1</b>	
18.	9/28/17	Thu	<i>Morphology of Crystalline polymers</i>	Read Chapter 6 Hmwk 6: #6.5, #6.7, #6.10, #6.16
19.	10/3/17	Tue	Crystallization Kinetics	<b>Hmwk 5 DUE:</b>
20.	10/3/17	Tue	Characterization of T <sub>m</sub> , T <sub>c</sub>	
21.	10/5/17	Thu	Liquid Crystalline Polymers	Read Chapter 7 Hmwk 7: #1, #3

22.	10/05/17	Thu	(Make-up for 10/12/17) Glass-Rubber Transitions	Read Ch 8 Hmwk 8: #8.3, #8.7, #8.12, #8.13
23.	10/10/17	Tue	Characterization of Thermal Transitions in polymers	<b>Hmwk 6 DUE</b>
24.	10/10/17	Tue	<i>Glass Transition theory</i>	<b>Quiz 3:</b>
25.	10/12/17	Thu	Make-up scheduled for 10/05/17 Period 5	
26.	10/17/17	Tue	Make-up scheduled to 10/19/17	<b>Hmwk 7 DUE</b>
27.	10/17/17	Tue	<i>Make-up scheduled to 10/26/17</i>	
28.	10/19/17	Thu	Glass Transition Theory – cont'd	
29.	10/19/17	Thu	(Make-up for 10/17/17) Glass Transition Theory – cont'd	
30.	10/24/17	Tue	Time Temperature Transformation, transitions in gels, ROM	<b>Hmwk 7.5: Research Proposal Topic (Canvas) by 11:59 PM</b>
31.	10/24/17	Tue	<i>T<sub>g</sub> for Miscible and non-Miscible Systems</i>	<b>QUIZ 4</b>
32.	10/26/17	Thu	T <sub>g</sub> and T <sub>m</sub> influence, Pressure effects	
33.	10/26/17	Thu	(Make-up for 10/17/17) REVIEW	
34.	10/31/17	Tue	<b>EXAM 2</b>	
35.	10/31/17	Tue	<b>EXAM 2</b>	
36.	11/2/17	Thu	Rubber Elasticity	Read Ch 8 Hmwk 8: #8.3, #8.7, #8.12, #8.13
37.	11/2/17	Thu	(Make-up for 10/17/17) Rubber Elasticity	
38.	11/7/17	Tue	Rubber Elasticity	Submit: Research Paper Outline (Canvas) by 11:59 PM
39.	11/9/17	Tue	Rubber Elasticity - Statistical Thermodynamics	
40.	11/9/17	Thu	Rubber Elasticity - Statistical Thermodynamics – cont'd	
41.	11/14/17	Tue	Rubber Elasticity - Statistical Thermodynamics – cont'd	Read Ch 9, Hmwk 9: Exercises 11.1, 11.3, 11.4, 11.10
42.	11/19/17	Tue	Rubber Elasticity – Gels cont'd	<b>Hmwk 8 DUE</b>
43.	11/19/17	Thu	Rubber Elasticity - Gels	
44.	11/21/17	Tue	Viscoelasticity	Read Ch. 10, Hmwk 10: 10.2, 10.3, 10.9, 10.16
45.	11/26/17	Tue	Viscoelasticity – cont'd	
46.	11/26/17	Thu	Viscoelasticity – cont'd	<b>Hmwk 9 DUE</b>
47.	11/28/17	Tue	Viscoelasticity – cont'd	<b>SUBMIT RESEARCH PAPER</b>
48.	12/3/17	Tue	Mechanical Deformation	Read Ch 11

				Hmwk 9: Exercises 11.1, 11.3, 11.4, 11.10
49.	12/3/17	Thu	<b>NO CLASS-HOLIDAY</b>	
50.	12/5/17	Tue	Mechanical Deformation	<b>Hmwk 10 DUE</b>
51.	12/5/17	Tue	Mechanical Deformation	
52.	12/11/17	Mon	<b>Exam 3: FINAL EXAM – GROUP 11A: 7:30 AM to 9:30 AM</b>	

NOTE: This schedule will serve as a guide to the subjects and approximate order in which they will be presented. However, in view of the interests of the class and available information subjects may be omitted and/or replaced. The dates are based upon the current academic calendar and will be adhered to as closely as possible. Every attempt will be made to re-schedule any lectures, which may be cancelled during this semester.