POLYMER CHARACTERIZATION

EMA 4462 Sections: O58G, OVER
Class Periods: MWF period 5 (11:45am – 12:35pm)
Location: Online Web
Academic Term: Spring 2021

Instructor:
Laurie Gower, Professor of Materials Science & Engineering
Email Address: LGower@mse.ufl.edu
Office Phone Number: 352-846-3336
Office Hours: TBD, Zoom office

Teaching Assistants:
Please contact through the Canvas website

- NA

Course Description
– Credits: 3 Grading Scheme: Letter
- Use of a broad variety of spectroscopic and other scattering phenomena in polymer research.

Course Pre-Requisites / Co-Requisites
- EMA 3066 or equivalent.

Course Objectives
This course will provide an overview of the common techniques for determining the structure and characteristics of polymeric materials. The goals of the course are as follows: 1) to equip the student with the knowledge necessary for deciding which characterization technique(s) would be appropriate for determining properties of interest; 2) to impart the student with sufficient background to enable the proper judgment of the quality of data obtained, and the significant variables effecting the results; 3) to enable the student to comprehend the polymer literature and make their own judgment regarding the interpretation of data. This course will not delve into techniques of general materials characterization except where the method differs when applied to polymers. Instead, the methods studied will typically be aimed at determining the polymer's size and molecular weight/distribution, primary structure of the backbone, nature of the chemical bonding environments, crystallinity, thermo/mechanical behavior, secondary conformations, tertiary morphology, surface or interfacial characteristics, etc..

Materials and Supply Fees: Distance learning fee

Professional Component (ABET): Professional Component (ABET): 3 credits engineering topics

Relation to Program Outcomes (ABET):

Outcome	Coverage*
1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, math, and science to solve complex problems in polymeric materials	High
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare,	Low

as well as global, cultural, social, environmental, and economic factors	
3. an ability to communicate effectively with a range of audiences	High
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	Low
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	Medium
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	High
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	Low

*Coverage is given as high, medium, or low. Outcomes are not assessed for ABET in the course.

Required Textbooks and Software

Lecture notes and supplementary readings will be provided by the instructor. Some chapters or supplemental reading can be obtained from the following books on reserve at the Marston Science Library.

Recommended Materials (on Reserve)

- Title: Comprehensive Desk Reference of Polymer Characterization and Analysis
- Author: Robert F. Brady, Jr.
- Publication date and edition: 2003 (American Chemical Society)
- ISBN number: 0841236658; 0841236658 (electronic via Hathi Trust one hour reading)

- Title: ESSENTIALS OF POLYMER SCIENCE AND ENGINEERING
- Author: PAINTER, PAUL C. AND COLEMAN, MICHAEL M.
- Publication date and edition: 2009 (DEStech Publications, Inc.)
- ISBN number: 1932078754 (hbk.); (used to have eBook)

- *<u>Book chapters listed in Schedule below are from this text:</u>
- Title: Polymer Characterization- Physical techniques
- Author: D. Campbell, R.A. Pethrick, J.R. White
- Publication date and edition: 1989 (Chapman and Hall)
- ISBN number: 0412271605; 0412271702 (pbk.)

Course Schedule (Tentative: 1/11/2021)

Lecture	Month	Date	Lecture Topic	Book Chapter*
1	Jan.	M 11	Class overview	Chapter 1
2		W 13	Review of polymer basics	

3		F 15	MW- primary methods (EGA;Colligative)	Chapter 2
		M 18	**Martin Luther King holiday**	
4		W 20	MLK Secondary methods: Viscometry	
5		F 22	Light scattering	Light scattering
6		M 25	GPC/SEC	GPC/SEC
7		W 27	Spectroscopy overview	Chapter 3
8		F 29	UV-Vis spectroscopy	Chapter 4
9	Feb.	M 1	Vibrational spectroscopy	Chapter 5
10		W 3	ATR-FTIR	
11		F 5	Raman	
		M 8	*Catch-up day*	
		T 9	***Evening Exam 1: Covers MW characterization***	
12		W 10	IR/Raman application to polymers	
13		F 12	Nuclear Magnetic Resonance Spectr.	Chapter 6
14		M 15	NMR: Shielding & Splitting	
15		W 17	Coupling, Double resonance techniques	
16		F 19	^{13}C and other nuclei; decoupling	
17		M 22	Relaxation times; pulse sequences	
18		W 24	Solid-state NMR	
20		F 26	2D NMR	
21	March	M 1	NMR applications with polymers	
22		W 3	Thermal Analysis- DTA/DSC	Chapter 12
23		F 5	Thermogravimetric analysis (TGA)	
		M 8	*Catch-up day*	
		T 9	***Evening Exam 2: Covers spectroscopy***	
24		W 10	Dynamic mechanical thermal analysis (DMTA)	
		F 12	DMTA cont.	
25		M 15	Surface properties: contact angle	Supplement
26		W 17	Surface chemical analysis (XPS/ESCA) (SIMS, time permitting)	Chapter 13
27		F 19	Microscopy- Light (contrast)	Chapter 11
28		M 22	Fluorescence Microscopy (time permitting)	Supplement

		W 24	**Recharge holiday**	
29		F 26	Polarized Light Microscopy	Chapter 11
		M 29	Polarized Light Microscopy-cont.	
30		W 31	Electron microscopy: TEM	Chapter 9
31	April	F 2	Electron microscopy: SEM	Chapter 10
32		M 5	Scanning probe microscopies (SPM)	Chapter 13.4
		W 7	***Final Project- student presentations***	
		F 9	***Final Project- student presentations***	
		M 12	***Final Project- student presentations***	
		T 13	***Evening Exam 3: Covers Thermal Analysis, Surface Analysis, Microscopy***	
		W 14	***Final Project- student presentations***	
		F 16	***Final Project- student presentations***	
		M 19	***Final Project- student presentations***	
		W 21	***Final Project- student presentations***	

F2F Course Policy in Response to COVID-19

We will have face-to-face instructional sessions to accomplish the student learning objectives of this course. In response to COVID-19, the following policies and requirements are in place to maintain your learning environment and to enhance the safety of our in-classroom interactions.

- You are required to wear approved face coverings at all times during class and within buildings. Following and enforcing these policies and requirements are all of our responsibility. Failure to do so will lead to a report to the Office of Student Conduct and Conflict Resolution.
- This course has been assigned a physical classroom with enough capacity to maintain physical distancing (6 feet between individuals) requirements. Please utilize designated seats and maintain appropriate spacing between students. Please do not move desks or stations.
- Sanitizing supplies are available in the classroom if you wish to wipe down your desks prior to sitting down and at the end of the class.
- Follow your instructor's guidance on how to enter and exit the classroom. Practice physical distancing to the extent possible when entering and exiting the classroom.
- If you are experiencing COVID-19 symptoms (Click here for guidance from the CDC on symptoms of coronavirus), please use the UF Health screening system and follow the instructions on whether you are able to attend class. Click here for UF Health guidance on what to do if you have been exposed to or are experiencing Covid-19 symptoms.
- Course materials will be provided to you with an excused absence, and you will be given a reasonable amount of time to make up work. Find more information in the university attendance policies.

Attendance Policy, Class Expectations, and Make-Up Policy

- **Attendance and Expectations:** Attendance will not be formally monitored, but classroom contribution to discussions will be noted and taken into consideration for participation grade. Therefore, you may want to notify me of any necessary absences. Excused absences must be consistent with university policies in the undergraduate catalog (https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx) and require appropriate documentation.
- **Homework**: Homework should be turned in by the stated deadlines on Canvas. No late submission will be accepted without prior approval in order that solutions can be posted after class.
- **Exams**: Only scientific non-programmable calculators are allowed during exams. Request one from me if you do not own or have access to one. A formula sheet will be provided during the exams (no notes or other sheets of paper should be present). A pen must be used for the final answer on the exams. Cell phones must be turned off and placed up-side-down during the exam.
- **Make-up Exam Policy:** Make-up exams will be provided with the prior approval of the instructor for excused absences. In general, acceptable reasons for excused absence include illness, serious family emergencies, special curricular requirements, military obligation, court-imposed legal obligations, religious holidays and participation in official university activities such as music performances, athletic competition or debate. If a make-up exam cannot be accomplished before the graded exams are returned, the missing exam score will be replaced by an average of the other two exam scores.
- **Grade changes:** Requests for adjustment to any grade should occur within the 2 week period following the posted grade in question, and must be approved by the course instructor (you can discuss your concerns with the TA, but the TA cannot change grades without final approval from me).
- **Policy on Cell Phones:** Cell phones should be turned off or on vibrate mode during class, with the exception of a primary care giver, who should notify me in advance (if/when receiving a call, promptly move to outside the classroom). Texting during class is not allowed, and you may be asked to leave.

Evaluation of Grades

Assignment	Total Points	Percentage of Final Grade
Homework Sets (≈ 10)*	100 each	10%
Exam 1	100 each	20%
Exam 2	100 each	20%
Exam 3	100 each	20%
Final Project	100 each	30%
		100%

Grading Policy

Percent	Grade	Grade Points
92 - 100	A	4.00
88 – 91.9	A-	3.67
84 – 87.9	B+	3.33
80 – 83.9	B	3.00
76 – 79.9	B-	2.67
72 – 75.9	C+	2.33
68 – 71.9	C	2.00
65 – 67.9	C-	1.67
62 – 64.9	D+	1.33
59 – 61.9	D	1.00
56 – 58.9	D-	0.67
0 – 55.9	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 who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting https://disability.ufl.edu/students/get-started/. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation
Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-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://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-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.

Commitment to a Safe and Inclusive Learning Environment
The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:
• Your academic advisor or Graduate Program Coordinator
• Robin Bielling, Director of Human Resources, 352-392-0903, rbielling@eng.ufl.edu
• Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
• Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

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: https://registrar.ufl.edu/ferpa.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 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 Discrimination, Harassment, Assault, or Violence
If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

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 suppor*t*, 352-392-4357 (select option 2) or e-mail to 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://care.dso.ufl.edu.

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