

## Structure and Mechanical Properties of Materials

EMA 6313 Sections: 13486-13489

**Class Periods:** T 4 (10:40 am - 11:30 am) and R 4-5 (10:40 am -12:35 pm)

**Location:** CSE E122

**Academic Term:** Fall 2018

*This course is one of the four key technical courses foundational to the MSE graduate program: Materials Thermodynamics (EMA 6316), Diffusion, Kinetics and Transport in Materials (EMA 6136), Structure and Mechanical Properties of Materials (EMA 6313), and Properties of Functional Materials (EMA 6114). As a core course, this class covers a significant amount of graduate-level material and it is designed to challenge you to advance your knowledge and skills. Success will require a considerable investment in preparing for lectures by using textbooks and other sources that you seek out, solving problems, and studying for exams. It is expected that you will have to exhibit significantly more independence, initiative, and ownership of the learning process than was required for success at the undergraduate level.*

### 1. Instructor:

**Dr. Juan C. Nino**

jnino@mse.ufl.edu

(352) 846 3787

Office Hours: M,W 10:00-11:00 am in 166 Rhines Hall; via e-mail or by appointment

### 2. Teaching Assistant:

Please contact through the Canvas website

- Andrew O'Connor, a.oconnor@ufl.edu, MSE Library, M,W 1:00-2:00 pm

### 3. Course Description

The course will cover fundamental principles governing the structure of materials and its implications on properties. Structure-property relations will be showcased by covering the mechanical properties of materials. (3 Credit Hours)

### 4. Course Pre-Requisites / Co-Requisites

EMA 6001 or successful placement exam is a pre-requisite for this course

### 5. Course Objectives

At the end of this course, students will be able to apply and utilize crystallography and related materials structure concepts to describe the atomic and molecular arrangement of materials and to establish structure-property relations with particular emphasis on mechanical properties of materials.

### 6. Required Textbooks and Software

- The Structure of Materials  
Samuel M. Allen and Edwin L. Thomas  
1999, 1<sup>st</sup> Edition  
ISBN 978-0-471-00082-2  
*The e-book for this course is available on CANVAS Bookshelf (VitalSource).*
- Mechanical Behavior of Materials  
Marc Meyers and Krishan Chawla  
2013, 2<sup>nd</sup> Edition  
ISBN 978-0-521-86675-0
- Crystal Maker and Crystal Diffract  
Download most recent installers from <http://www.crystalmaker.com/>

This course will use CANVAS extensively as a communication and archival tool. The students can access all relevant course information (course notes, homework, problem sets, solutions, announcements, grades, etc.) via the CANVAS entry link: <https://elearning.ufl.edu/>

## 7. Course Schedule

Below is the intended/tentative schedule of classes and exams.

Date	Topic	Reading Assignments		Background Reading
		Canvas	Allen = A; Meyers = M	Callister
	<b>Introduction</b>			
23-Aug	Course Description, Objectives, Methodology, and Background Review	S1		Ch 1-22
	<b>Structure of Materials</b>			
28-Aug	Molecular Orbital Theory and Principles of Stereochemistry	S2	Supplemental Notes (SN)	Ch 2
30-Aug	Elements of Symmetry and Noncrystalline State Descriptors	S3	A: Ch 1.2 Ch 2.1-2.3	Ch 12
4-Sep	Network Models and Fractals	S4	A: Ch 2.4-2.5	
6-Sep	Crystalline State: 2D Symmetry, 2D Point Groups	S5	A: Ch 3-3.1.5	
11-Sep	Crystalline State: Plane Groups, Patterns	S6	A: Ch 3.1.6 -3.1.7	
13-Sep	Exercises (Set 1)	S7		
<b>18-Sep</b>	<b>FIRST EXAM (25%)</b>			
20-Sep	Crystalline State: 3D Symmetry, 3D Point Groups	S8	A: Ch 3.2-3.2.5	Ch 3
25-Sep	Crystalline State: Space Groups, International Tables	S9	A:Ch 3.2.6-3.2.7	
27-Sep	Crystal Structures, Structure of Metals, Structure of Ceramics	S10	A: Ch 3.4 + SN	Ch 12
2-Oct	Diffraction, Structure of Glass and Semi-crystalline Systems	S11	A: Ch 3.5 + SN	
4-Oct	Structure of Polymers, Classification, Crystallinity, Liquid Crystals	S12	A: Ch 4-4.4.2	Ch 14
9-Oct	Structure of Composites, Structure of Biologics	S13	M: Ch 1.3.7-1.3.9 + SN	
11-Oct	Exercises (Set 2)	S14		
<b>16-Oct</b>	<b>SECOND EXAM (25%)</b>			
18-Oct	Symmetry Constraints on Materials Properties - Tensors	S15	A: Ch 3.3	
23-Oct	Elasticity and Viscoelasticity Review	S16	M: Ch 2-2.5	Ch 6
25-Oct	Complex Stress States + Stiffness, Compliance, and Anisotropy	S17	M: Ch 2.6-2.9	
30-Oct	Elastic Properties of Polycrystals, Polymers, Composites and Biologics	S18	M: Ch 2.10-2.15	
1-Nov	Exercises (Set 3)	S19		
<b>6-Nov</b>	<b>THIRD EXAM (25%)</b>			
8-Nov	Plastic Deformation, Strain Rate Effects, Tension vs. Compression	S20	M: Ch 3-3.4	
13-Nov	Plastic Deformation of Polymers, Glasses, and Biologics	S21	M: Ch 3.5-3.7	
15-Nov	Fracture in Materials	S22	M: Ch 7-8	Ch 8
20-Nov	Creep and Superplasticity	S23	M: Ch 13	
27-Nov	Fatigue	S24	M: Ch 14	
29-Nov	Exercises (Set 5):Kinetics, Mechanical Properties...	S25		
<b>4-Dec</b>	<b>FOURTH EXAM (25%)</b>			
<b>11-Dec</b>	<b>FINAL EXAM (COMPREHENSIVE, 25%)*</b>			

The instructor reserves the right to make changes to the syllabus as needed. Any changes will be clearly announced on Canvas and in class.

## 8. Attendance Policy, Class Expectations, and Make-Up Policy

Attendance is strongly suggested since it is the best way to actively engage with the instructor while the topics are covered and get any clarifying question you may have answered right when they arise. In addition, a number of exercises will be worked out in class in small groups and this will help as preparation for the exams.

Proper behavior in class is always important and leads to a relaxed and productive educational environment.

Thus, eating, drinking, texting, news reading, social media use, working on homework for this or other courses, 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, WILL be asked to leave the classroom.

Leaving early or arriving late can be VERY distracting, you should avoid it. All electronic devices (laptops, mobile phones, etc.) should be turned off or in silent mode. If your mobile phone rings during class, it will be confiscated for the remainder of the class period. The use of smartphones, laptops, tablets or similar personal computers is not allowed unless specific in-class activities requires them, and when explicitly indicated by the instructor. Exceptions may be granted if explicitly requested by the individual student the first day of class and for note taking purposes only. This class is being recorded so no additional audio/video recording is allowed..

Students not presenting an exam will receive a grade of 0. There will be no make-up for a missed exam.

Instead, a final comprehensive exam will be offered to any student that wants to substitute their lowest score in the four regular exams.

Excused absences must be consistent with university policies in the Graduate Catalog and require appropriate documentation. Additional information can be found here:

<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>

## 9. E-mail Communication

ONLY e-mail me at [jnino@mse.ufl.edu](mailto:jnino@mse.ufl.edu). DO NOT USE CANVAS MAIL. Furthermore, because of the volume of e-mails I receive, you always need to identify yourself and the course. In the subject line you should always include the course number (EMA6313) and your first and last name. Please begin your e-mail with a salutation. [I know that personal e-mails and texts are often sent without even a name to address the recipient at the opening of the communication, but professionally that is unacceptable]. Close your e-mails by typing your name. Check your e-mail for grammar and spelling. Be concise. All of these guidelines are to promote professionalism.

## 10. Evaluation of Grades

Assignment	Total Points	Percentage of Final Grade
Four Exams	25 each	100%
Optional Final Exam	25	Replaces lowest score <u>even</u> if lower than the lowest regular exam

Exams will be closed book. All relevant backup information considered sufficient and necessary to answer the questions will be included in the exam booklet. Students are allowed to bring one letter-sized paper (8½"x11") with machine printed equations, annotations and any relevant information, all on a single page. **NO PEN or PENCIL ANNOTATIONS, glued pages or similar deviations from a simple printed page are allowed.** Printing on both sides (if needed) is allowed.

## 11. Grading Policy

The final grade of the course will be calculated based on the percentage of maximum course score as follows:

Percentage	≥92	≥88	≥84	≥80	≥76	≥72	≥68	≥65	≥62	≥59	≥56	<56
Letter Grade	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	E
Grade Points	4.0	3.67	3.33	3.0	2.67	2.33	2.0	1.67	1.33	1.0	0.67	0

In the event that the class average is below 72%, the distribution will be shifted so that the average equals 72%. In order to graduate, graduate students must have an overall GPA and an upper-division GPA of 3.0 or better (B or better). Note: a B- average is equivalent to a GPA of 2.67, and therefore, it does not satisfy this graduation requirement.

More information on UF grading policy may be found at:

<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

### 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/scsr/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 in this class. (See page 5 of this syllabus)

### 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, see: <http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html>

### ***Campus Resources:***

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

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

If you or a friend is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu) or 352 392-1575 so that a team member can reach out to the student.

**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>.

## UNIVERSITY OF FLORIDA

### Student Honor Code (Abridged)

**Preamble:** In adopting this Honor Code, the students of the University of Florida recognize that academic honesty and integrity are fundamental values of the University community. Students who enroll at the University commit to holding themselves and their peers to the high standard of honor required by the Honor Code. Any individual who becomes aware of a violation of the Honor Code is bound by honor to take corrective action. Student and faculty support are crucial to the success of the Honor Code. The quality of a University of Florida education is dependent upon the community acceptance and enforcement of the Honor Code.

**The Honor Pledge:** We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty 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."**

#### **Violations of the Student Honor Code include (in part):**

(a) **Plagiarism**, in the form of quoting oral or written materials including but not limited to those found on the internet, whether published or unpublished, without proper attribution; or submitting a document or assignment which in whole or in part is identical or substantially identical to a document or assignment not authored by the student.

(b) **Unauthorized use of Materials or Resources ("Cheating")**. A student shall not use unauthorized materials or resources in an academic activity. Unauthorized materials or resources shall include:

1. Any paper or project authored by the student and presented by the student for the satisfaction of any academic requirement if the student previously submitted substantially the same paper or project to satisfy an academic requirement.
2. Any materials or resources prepared by another student and used without the other student's express consent or without proper attribution to the other student.
3. Any materials or resources that the faculty member has prohibited.
4. Use of a cheat sheet when not authorized to do so or use of any other resources or materials during an examination, quiz, or other academic activity without the express permission.

(c) **Prohibited Collaboration or Consultation**. A student shall not collaborate or consult with another person on any academic activity unless the student has the express authorization.

1. Prohibited collaboration or consultation shall include but is not limited to:
  - Collaborating when not authorized to do so on an examination, take-home test, writing project, assignment, or course work.
  - Collaborating or consulting in any other academic or co-curricular activity after receiving notice that such conduct is prohibited.
  - Looking at another student's examination or quiz during the time an examination or quiz is given. Communication by any means during that time, including but not limited to communication through text messaging, telephone, e-mail, other writing or verbally, is prohibited unless expressly authorized.
2. It is the responsibility of the student to seek clarification on whether or not use of materials or collaboration or consultation with another person is authorized prior to engaging in any act of such use, collaboration or consultation.