Structure and Mechanical Properties of Materials

EMA 6313 Sections: 12277-12280 & 24553
Class Periods: T 2-3 (8:30 am – 10:25 am) and R 3 (9:35 am – 10:25 am)
Location: NEB 201
Academic Term: Fall 2025

This course is one of 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 Claudio Nino
jnino@mse.ufl.edu, +1 (352) 846 3787
Office Hours: M, W 10:30-11:30 am in 166 RHN or Zoom (first come, first served); otherwise, via e-mail or by appointment.

2. Teaching Assistant:

- TBA, meeting by appointment in MSE Library or Zoom. Please post all your open questions in the Discussions within CANVAS before contacting the TA.

3. Course Description

The course will cover fundamental principles governing the structure of materials and their 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

It is strongly recommended that the students have taken EMA 6001 or an Introduction to Materials Science and Engineering course as part of their undergraduate courses. Students taking EMA 6313 should not be enrolled in EMA 6001 simultaneously.

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 establish structure-property relations with particular emphasis on mechanical properties.

6. Required Textbooks and Software

- Crystals and Crystal Structures
  Richard J. D. Tilley
  2020, 2nd Edition - Wiley
  ISBN 978-1-119-54838-6
- Mechanical Behavior of Materials
  Marc Meyers and Krishan Chawla
  2025, 3rd Edition - Cambridge
  ISBN 978-1-108-83790-3
- Crystal Maker and Crystal Diffract
  Download the most recent installers from http://www.crystalmaker.com/
- Students should identify on an individual basis any additional resources required to ensure they have the necessary background in IUPAC nomenclature of organic chemistry, linear algebra, and introduction to materials science. See, for example:
  - https://en.wikipedia.org/wiki/IUPAC_nomenclature_of_organic_chemistry;
  - https://cnx.org/contents/mwjClAV_@10.3:UIpNTgE2@10/7-5-Matrices-and-Matrix-Operations
  - https://www.symbolab.com/solver/matrix-calculator;
  - Fundamentals of Materials Science and Engineering: An Integrated Approach by William D. Callister, Jr. and D.G. Rethwisch, 2021 Sixth Edition (John Wiley & Sons, Inc.); ISBN: 978-1-119-68894-5

This course will use CANVAS extensively as a communication and archival tool. Students can access all relevant course information (course notes, homework, problem sets, discussions, announcements, grades, etc.) via the CANVAS entry link: https://elearning.ufl.edu/
Our class sessions will be audio-visually recorded for students in the class to refer back to and for enrolled online students who are unable to attend live. Students who participate in class agree to being recorded.

7. Required Computer

Recommended Computer Specifications: https://it.ufl.edu/get-help/student-computer-recommendations/
HWCOE Computer Requirements: https://www.eng.ufl.edu/students/advising/fall-semester-checklist/computer-requirements//

8. Course Schedule

Below is the intended/tentative schedule of classes and exams. All assignments are take-home and submitted on Canvas with a minimum of 4 days between assignment posting and submission deadline. Please note that being an online student presupposes that you have ample support from your employer (if any) to take care of your student responsibilities. Therefore, **ONLINE students are expected to turn in all assignments by the same deadline as students in the regular (campus) sections**. If this represents a significant conflict with their employer or similar, students should contact the instructor by the second day of classes to resolve the situation. However, given the advanced notice, it is understood that these guidelines and deadlines stand. The instructor reserves the right to make changes to the syllabus as needed. Any changes will be clearly announced on Canvas and in class.

Date	TOPIC	Reading Assignments		Background Reading
	Introduction	**Canvas**	**Tilley = T; Meyers = M**	**Callister**
21-Aug	Introduction, MSE Background Review, Linear Algebra Review	S1		Ch 1-22
26-Aug	Bonding Theories	S2	OpenStax Ch 4-5	Ch 2
	Principles of Stereochemistry	S3	Loudon Ch 6	Ch 4
28-Aug	Q&A + In-class Exercises	QA		
2-Sep	Elements of Symmetry and Noncrystalline State Descriptors	S4	T: Ch 3	Ch 3
	Fractals	S5	Wahl Ch 4	
4-Sep	Q&A + In-class Exercises	QA		
9-Sep	Crystalline State: 2D Symmetry, 2D Point Groups	S6	T: Ch 1-2	
	Crystalline State: Plane Groups, Patterns	S7	T: Ch 3	
11-Sep	Q&A + In-class exercises	QA		
16-Sep	Crystalline State: 3D Symmetry, 3D Point Groups	S8	T: Ch 4	
	Crystal Structures, Structure of Metals, Structure of Ceramics	S9	T: Ch 6	Ch 3
18-Sep	Q&A + In-class exercises	QA		
Quiz 1 (S1-S7) due ON CANVAS before Monday September 22nd at 11 pm				
23-Sep	Diffraction and Crystallographic Software	S10	T: Ch 7	Ch 14
	Colloids and Liquid Crystals	S11	Allen: Ch 4	
25-Sep	Q&A + In-class exercises	QA		
30-Sep	Structure of Polymers, Classification, Crystallinity	S12	Supplemental Notes	Ch 4
	Structure of Composites, Structure of Biologics	S13	M: Ch 1.3.7-1.3.9 + SN	Ch 15
2-Oct	Q&A + In-class exercises	QA		
7-Oct	Elasticity Review	S14	M: Ch 2-2.5	Ch 7
	Symmetry Constraints on Materials Properties - Tensors	S15	Supplemental Notes	
10-Oct	Q&A + In-class exercises	QA		
14-Oct	Elastic Properties (Polycrystals), Polymers, Composites & Biologics	S16	M: Ch 2.10-2.15	Ch 7
	Complex Stress States + Stiffness and Compliance	S17	M: Ch 2.6-2.9	
16-Oct	Q&A + In-class exercises	QA		
Quiz 2 (S8-S15) due ON CANVAS before Monday October 20th at 11 pm				
21-Oct	Stiffness and Compliance Anisotropy	S18	M: Ch 2.6-2.9	
23-Oct	Q&A + In-class Exercises	QA		
28-Oct	Viscoelasticity	S19	M: Ch 2-2.5	Ch 7
	Plastic Deformation, Strain Rate Effects, Tension vs. Compression	S20	M: Ch 3-3.4	
30-Oct	Q&A + In-class exercises	QA		
4-Nov	Strengthening Mechanisms	S21		Ch 8
	Fracture in Materials	S22	M: Ch 7-8	Ch 9
6-Nov	Q&A + In-class exercises	QA		
13-Jan	Griffith Crack Theory I	S23	M: Ch 7-8	Ch 9
18-Nov	Griffith Crack Theory II	S24	M: Ch 7-8	Ch 9
	Creep and Superplasticity	S25	M: Ch 13	Ch 9
20-Nov	Q&A + In-class exercises	QA		
Quiz 3 (S16-S24) due ON CANVAS before Monday November 24th at 11 pm				
2-Dec	Course Review			
	Course Evaluation			
Second Chance at Mastering Topics Quiz due on CANVAS before Monday December 8th at 11 pm				

9. Evaluation of Grades

Assignment	Total Points	Percentage of Final Grade
Quiz 1	30	Up to 30% of 100 points
Quiz 2	35	Up to 35% of 100 points
Quiz 3	35	Up to 35% of 100 points
Second Chance Quiz (10 points)	Up to 10 points total	Up to 10% of 100 points
110 possible total points, yet graded on a total 100-point basis. This is essentially a built-in 10% extra credit or cushion.		

Quizzes (Q) will be presented on CANVAS. Specific guidelines for the Qs will be posted on CANVAS well in advance. Quizzes will open on Thursdays after the class period and are due any time before the following Monday at 11 pm, as indicated on the schedule. Total: the raw scores of all three quizzes, and the second-chance quiz (if presented) will be added and count towards the grade on a points scale. Theoretically, a student can score up to 110 points in the course. Regardless, the final grade will be calculated on a 100-point basis. For example, 92 out of 110 possible points is sufficient to earn students an A (see next section).

PLEASE NOTE: As this course focuses on the descriptors of matter and its properties, grading values and rewards precision, accuracy, and correctness of the answers and the methods employed. Moreover, because evaluations are taken at home with essentially open resources, grading of problems is typically binary: right or wrong, and partial credit is extremely rare. Therefore, to perform well in the exams, students will need to consistently practice solving relevant problems and checking the correctness of their answers and methods well before the exam via discussions, office hours, and study groups.

10. Grading Policy

The final grade of the course will be calculated based on the total points scored as follows:

Points	≥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

If the class average is below 72 points, the distribution will be shifted so that the average equals 72 points. 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; therefore, it does not satisfy this graduation requirement. More information on UF grading policy can be found at: UF Graduate Catalog and Grades and Grading Policies.

11. Attendance Policy, Class Expectations, and Make-Up Policy

Attendance for campus students is mandatory as it is the best way to engage actively with the instructor and fellow students. At the same time, clarifying questions about the covered topics get answered right when they arise. In addition, several exercises will be done in class before the quizzes.

Proper behavior during class is always essential and leads to a relaxed and productive educational environment. Students who behave disorderly or disrespectfully WILL be asked to leave the classroom. Students who do not submit an assignment on time will receive a zero (0), and there will be no make-up for a missed quiz. Excused absences must be consistent with university policies in the Graduate Catalog (https://catalog.ufl.edu/graduate/regulations) and require appropriate documentation. Additional information can be found here: https://gradcatalog.ufl.edu/graduate/regulations/.

12. Communication

I prefer to be emailed directly at jnino@ufl.edu instead of CANVAS mail; however, you can choose which system to use. Furthermore, because of the volume of e-mails I receive, please include the course number (EMA6313) in the subject line, followed by the subject of your message. Please begin your email with a salutation. [I know that personal emails and texts typically do not even have a name to address the recipient at the opening of the communication, but professionally, that is unacceptable.] Close your emails by typing your name. Check your e-mail for grammar and spelling. Be concise. All of these guidelines are to promote professionalism.

13. Academic Policies & Resources

For additional details about UF's academic policies and resources, students are encouraged to visit: https://go.ufl.edu/syllabuspolicies. UF General Academic Policies & Resources (Honor Policy, DRC, Academic and Health Resources): https://go.ufl.edu/syllabuspolicies Graduate Level Academic Policies and Regulations (Attendance and Grading policy): https://gradcatalog.ufl.edu/graduate/regulations/

14. 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 violate this code and the possible sanctions. Furthermore, you must 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 4 of this syllabus.)

15. Commitment to a Safe and Inclusive Learning Environment

The College of Engineering values varied perspectives and lived experiences within our community and is committed to supporting the University's core values.

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
- HWCOE Human Resources, 352-392-0904, student-support-hr@eng.ufl.edu
- Pam Dickrell, Associate Dean of Student Affairs, 352-392-2177, pld@ufl.edu

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 depends on the community acceptance and enforcement of the Honor Code.

As a result of completing the registration form at University of Florida, every student has signed the following statement:

I understand that the University of Florida expects its students to be honest in all their academic work. I agree to this commitment to academic honesty and understand that my failure to comply with this commitment may result in disciplinary action up to and including expulsion from the University.

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 for the satisfaction of any academic requirement if the student previously submitted substantially the same paper or project to satisfy an educational requirement.
2. Any materials or resources prepared by another student and used without the other student's express consent or proper attribution to the other student.
3. Any materials or resources the faculty member has prohibited or not given EXPRESS permission to use..
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, assignment, or coursework.
   - Collaborating or consulting in any academic 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 the use of materials, collaboration, or consultation with another person is authorized before engaging in any act of such use, collaboration, or consultation.

Other violations include (in part):

- Commissioning or seeking to commission another person or Entity, with or without compensation, to produce or complete academic work or to impersonate a student in any educational activity.
- Impersonating another person in any academic activity or providing an unfair academic advantage to another person by producing or completing academic work or activities on behalf of another person, with or without compensation.
- Complicity in Violating the Student Honor Code. Attempting, aiding, encouraging, facilitating, abetting, conspiring to commit, hiring someone else to commit, giving or receiving bribes to secure, or being a participant (by act or omission) in any act prohibited by this Regulation.
- Submission of Academic Work Purchased or Obtained from an Outside Source. A Student must not submit as their own work any academic work in any form that the Student purchased or otherwise obtained from an outside source, including but not limited to: academic work in any form generated by an Entity; academic materials in any form prepared by a commercial or individual vendor of academic materials; a collection of tests, or academic materials maintained by a Student Organization or other entity or person, or any other sources of academic work.
- Unauthorized Taking or Receipt of Materials or Resources to Gain or Provide an Improper Academic Advantage. A Student, independently or with another person or Entity or other people or Entities, must not without express written authorization take, give, possess, post, submit, transmit, or receive materials, information, or resources in any manner, through any medium, for gaining or providing an improper academic advantage to any Student.