

**EMA 6313 – Structure and Mechanical Properties of Materials**  
**Sections 13522 (EDGE), 13523 (Campus), 13524 (EDGE)**

*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. Course Description:** This course focuses on the structure and properties of materials. It covers the structure of materials and their mechanical properties. Structure of materials includes the crystal structure, crystal symmetry, structure of amorphous materials, defects and microstructure, and the experimental methods for materials structure analysis. Mechanical properties address the relationship between microscopic mechanisms and macroscopic mechanical behavior of materials, including stress, strain, and elastic coefficients as tensor quantities, plastic deformation, creep, fracture, and fatigue. (3 credit hours).

**2. 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.

**3. Prerequisites:** EMA6001 or successful placement exam

**4. Instructor: Dr. Jennifer Andrew (she/her)**

- a. E-mail address: jandrew@mse.ufl.edu
- b. Office hours: **W 4:30-6:30p**
- c. Office hours location: Zoom (link in Canvas)
- c. Website: <https://elearning.ufl.edu/>

**5. Teaching Assistant: Vivek Muralikrishnan**

- a. Office hours location: Zoom (link in Canvas)
- b. E-mail address: muralikrishnan.v@ufl.edu
- c. Office hours: **T 5:00-6:30p**

**6. Meeting Times and Location: T Period 2 & 3 8:30a-9:20a & 9:35a-10:25a CSE E107**  
**R Period 3 9:35a-10:25a CSE E107**

Online Course Recording. Our class sessions may be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

7. Textbooks Required and Software

1a. Title: *Crystals and Crystal Structures*

1b. Author: **Richard J. D. Tilley**

1c. Edition: **2<sup>nd</sup>**

1d. ISBN: **978-1-119-54838-6**

2a. Title: *Mechanical Behavior of Materials*

2b. Author: **Marc Meyers and Krishan Chawla**

2c. Edition: **2<sup>nd</sup>**

2d. ISBN: **978-0-521-86675-0**

3a. Title: **Crystal Maker and Crystal Diffract** (<http://crystallmaker.com>)

8. Recommended Reading

1a. Title: *Fundamentals of Materials Science and Engineering: An Integrated Approach*

1b. Author: **William D. Callister, Jr. and David G. Rethwisch**

1c. Edition: **4<sup>th</sup>**

1d. ISBN: **978-1-118-06160-2**

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

10. **Conduct, Attendance and Expectations:** Proper behavior in class is always important and leads to a relaxed and productive educational environment. Excused absences must be in compliance with university policies in the Graduate Catalog: (<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance>), and require appropriate documentation.

11. **Grading and Grading Scale:** Your final grade will be allocated based on the following distribution:

Homework: 25%  
Three In-Class Exams: 25% each

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

The instructor reserves the right to adjust the grade distributions, however grades **will not** be adjusted for individuals.

Exams. You will be given 3 exams throughout the semester, the exam content may change but the dates will not. **There will be no final exam.** Each exam is weighted equally and will be worth 25% of your final grade. Requests for re-grading must be made in writing and within one week after an assignment has been returned. **Make-up exams** will be provided only with the *prior approval of the instructor or excused absence*. 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.

Homework. Homework problems will be assigned, together with due dates, through e-Learning. These homework questions are *essential* to your study and some exam questions will be adapted from them.

Homework will be posted through the Canvas web site. Assignments are due **online through Canvas in .pdf format** on the due date, unless otherwise stated. **Late homework assignments will not be accepted and will receive a grade of zero.** The lowest homework score will be dropped.

**12. Course Outline:** Below is the tentative schedule of topics, activities, reading assignments, and exams.

<b>Week of</b>	<b>Topic</b>	<b>Reading (Tilley =T, Meyers=M )</b>	<b>Background (Callister)</b>
8/23/21	Introduction, MSE Background, Bonding Theories		Ch. 2
8/30/21	Bonding in Molecules, Nomenclature, Noncrystalline Materials		
9/6/21	Crystalline Materials: Lattices, Planes Directions, Symmetry in 2D	T: Ch.2-3	Ch. 3
9/13/21	Fractals, Symmetry and Point Groups in 3D, Structure of Materials	T: Ch. 4, Ch. 1	Ch. 3
9/20/21	Crystal Structure of Metals and Ceramics	T: Ch. 6	
9/27/21	Diffraction, Crystallographic Software	T: Ch. 7	Ch. 3
<b>EXAM 1</b>	<b>Tues. September 28</b>		
10/4/21	Structure of Polymers and Biologics, Colloids, Liquid Crystals	M: Ch. 1.3.5-1.3.10	Ch. 4
10/11/21	Composites	M: Ch. 15	Ch. 15
10/18/21	Mechanical Properties- Elasticity	M: Ch. 2-2.5	Ch. 7
10/25/21	Mechanical Properties, Anisotropy, Linear Algebra Review	M: Ch. 2.6-2.11	
11/1/21	Mechanical Properties- Viscoelasticity	M: Ch. 2.12-2.17	
<b>EXAM 2</b>	<b>Tues.. November 2</b>		
11/8/21	Mechanical Properties- Plasticity, Point Defects	M: Ch. 3, 4.1-4.3	Ch. 8, Ch. 5
11/15/21	Line Defects, Volume Defects	M: Ch. 4.4 Ch. 5	Ch. 8
11/22/21	Mech. Properties- Strengthening Mechanisms, Fracture	M: Ch. 10, 7-9	Ch. 9
11/25/21	<i>Thanksgiving Day (No Class)</i>		
11/29/21	Creep and Superplasticity, Fatigue	M: Ch. 13-14	Ch. 9
<b>EXAM 3</b>	<b>Tues. December 7</b>		

**13. In-Class Recording** – Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation,

assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

**14. 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.

**15. 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/>.

**16. 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.

**17. 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](mailto:rbielling@eng.ufl.edu)
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto:taylor@eng.ufl.edu)
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, [nishida@eng.ufl.edu](mailto:nishida@eng.ufl.edu)

**18. Software Use** – All faculty, staff and student 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.

**19. 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>

## **20. 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 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](mailto: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/>.

### **COVID-19**

- You are expected to wear approved face coverings at all times during class and within buildings even if you are vaccinated.
- If you are sick, stay home and self-quarantine. Please visit the UF Health Screen, Test & Protect website about next steps, retake the questionnaire and schedule your test for no sooner than 24 hours after your symptoms began. Please call your primary care provider if you are ill and need immediate care or the UF Student Health Care Center at 352-392-1161 (or email [covid@shcc.ufl.edu](mailto:covid@shcc.ufl.edu)) to be evaluated for testing and to receive further instructions about returning to campus.
- If you are withheld from campus by the Department of Health through Screen, Test & Protect, you are not permitted to use any on campus facilities. Students attempting to attend campus activities when withheld from campus will be referred to the Dean of Students Office.
- UF Health Screen, Test & Protect offers guidance when you are sick, have been exposed to someone who has tested positive or have tested positive yourself. Visit the [UF Health Screen, Test & Protect website](#) for more information.
- Please continue to follow healthy habits, including best practices like frequent hand washing. Following these practices is our responsibility as Gators.

### Academic Resources

**E-learning technical support**, 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://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>.