

## **Microstructural Characterization and Analysis**

EMA 6938 All Sections

**Class Periods:** Monday/Wednesday/Friday, Period 3 (9:35-10:25am)

**Location:** Virtual

**Academic Term:** Fall 2020

### **Instructor:**

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(352) 294-6609  
Office Hours: TBA

### **Course Description**

Credit hours: 3

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

None

### **Course Objectives**

Many mechanical and electrical material properties are dependent on the materials' microstructure. This class will introduce students to the characterization tools and analytical methods for quantifying microstructural features used to elucidate fundamental structure-property relationships. The class will discuss crystallographic symmetry and anisotropy, diffraction techniques, and orientation representations.

**Purpose:** The motivation of this class is:

- To illustrate the significance of microstructural features like texture and grain boundary character on material properties.
- To develop computational skills and quantitative tools for microstructural analysis.
- To demonstrate the common themes and differences between the diffraction techniques (electron, x-ray, and neutron) for microstructural texture analysis.

**Outcomes:** At the end of this course, students will be able to:

- (1) Represent crystallographic orientation and grain boundary character using different notations (*e.g.* Euler angles, Rodrigues vectors, etc.)
- (2) Analyze orientation data produced by diffraction techniques, and
- (3) Create and interpret visual representations (*e.g.* pole figures) of grain texture and grain boundary character distributions.

### **Course Delivery:**

The class will be held virtually through a provided, password-protected Zoom link. The class will be synchronous, *i.e.* the lectures will be delivered live during the listed course times.

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.

### ***Required Textbooks and Software***

- Title: Introduction to Texture Analysis – Macrotexture, Microtexture, and Orientation Mapping
- Authors: Olaf Engler and Valerie Randle
- Publication date and edition: 2<sup>nd</sup> Edition (2010)
- ISBN number: 978-1-4200-6365-3

Software: Students will be asked to do scripting in Matlab®, Python, Octava or other preferred language to complete the class assignments. Class assignments will also require the free software Dream.3D and Paraview during the course of the semester.

### ***Course Schedule***

<b>Week: (Monday Date)</b>	<b>Topic</b>	<b>Assignments</b>
1: Aug 31	Introduction Crystallography	
2: Sept 7	Crystallography	Term Paper Subject Submission
3: Sept 14	Descriptors of Orientation	Homework
4: Sept 21	Diffraction/X-ray diffraction	
5: Sept 28	Electron Backscattered Diffraction	Homework
6: Oct 5	TBA	
7: Oct 12	Other Diffraction Techniques	
8: Oct 19	Orientation Distribution Visualization	Term Paper Draft
9: Oct 26	Texture Representation	
10: Nov 2	Grain Boundaries	Homework
11: Nov 9	Grain Boundaries	
12: Nov 16	Microstructure Evolution	Homework
13: Break	<b>BREAK</b>	
14: Nov 30	Presentations	Presentation
15: Dec 7	Presentations	Presentation and Term Paper

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

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.

**Class Attendance:** Attendance is expected and all class notes are the responsibility of the student. In class assignments (including Canvas recorded questions) will count as a record of attendance. Thus, the penalty for unexcused absences is a lower grade.

**Homework Assignments:** Homework will be completed individually and will be due at 8:30am on the due date. Homework turned in 24 hours late will receive a reduction in grade by 10 percent. No late homework will be accepted for credit after 24 hours on the day following the due date. (For example, homework due on Tuesday at 8:30pm will not be collected after Wednesday at 8:30am.) This grading policy is also applicable to the term paper.

**Presentation Makeup Policy:** Any missed presentations will count as zero unless a written excuse is submitted before the presentation. The make-up presentation must be given at the earliest possible date. Emergencies that arise will have to be documented by the appropriate authority.

## ***Evaluation of Grades***

Assignment	Percentage of Final Grade
Homework	30%
Participation	10%
Term Paper	30%
Final Presentation	30%
Total	100%

## ***Grading Policy***

Percent	Grade	Grade Points
92 – 100	A	4.00
88 – 92	A-	3.67
84 – 88	B+	3.33
80 – 84	B	3.00
76 – 80	B-	2.67
72 – 76	C+	2.33
68 – 72	C	2.00
65 – 68	C-	1.67
62 – 65	D+	1.33
59 – 62	D	1.00
56 – 59	D-	0.67
< 56	E	0.00

More information on UF grading policy may be found at:

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

**Syllabus Changes:** I reserve the right to make changes in the syllabus and class schedule as needed. Any changes will be announced clearly on canvas and in class.

### ***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.bluer.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.

### ***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)

### ***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](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/>.

### *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://care.dso.ufl.edu>.

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