

## **X-Ray Methods for Material Characterization**

EMA 6516 class number 14245

**Class Periods:** T 7<sup>th</sup> period (1:55-2:45), Th 7-8<sup>th</sup> period (1:55-3:50)

**Location:** CSE E118

**Academic Term:** Spring 2019

### ***Instructor:***

Kristy Schepker

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Office phone: 273-2252

Office Hours: Tu 8<sup>th</sup> period

### ***Course Description***

Provides an introduction to the principles and methods of materials characterization via x-ray interactions. The course will focus primarily on diffraction and scattering techniques for crystallographic and thin film analysis.

### ***Course Objectives***

This course is meant to serve as an introduction to X-ray characterization techniques and data interpretation. We will discuss theory of the techniques, sample preparation, and will review some publications to see the techniques being used in current research. Students will be assessed on their attendance, quiz scores, and exam scores.

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

\*Digital texts available for download through UF library

- Crystallography: An introduction
  - Walter Borchardt- Ott
  - Third Edition, 2011
  - ISBN: 9783642164514
  
- Fundamentals of Powder Diffraction and Structural Characterization of Materials
  - Pecharsky and Zavalij
  - Second Edition, 2009
  - ISBN: 9780387095783

\*\*Course notes are developed by instructor utilizing required and recommended texts and other online materials

### ***Recommended Materials***

- X-Ray Diffraction: A Practical Approach
  - C. Suryanarayana, M. Grant Norton
  - 1998, First Edition
  - ISBN 9780306457449
  
- Thin Film Analysis by X-Ray Scattering
  - Mario Birkholz
  - 2006, First Edition
  - ISBN 9783527310524
  
- Elements Of X Ray Diffraction
  - Cullity, B. D
  - 1956, First Edition

More affordable options:

- X-Ray Diffraction: In Crystals, Imperfect Crystals, and Amorphous Bodies
  - A. Guinier
  - 1994, First Edition (Dover)
  - ISBN 9780486680118
  
- Introduction to Crystallography
  - Donald E. Sands
  - 1993, First Edition (Dover)
  - ISBN 9780486678399

***Anticipated Course Schedule- subject to change as needed***

Week 1:	Introduction/ x-ray properties	
Week 2:	X-ray history and generation of x-rays	
Week 3:	X-ray detection and uses in characterization	
Week 4:	Crystal symmetry and lattices .....	<b>Quiz: x-rays (Tu)</b>
Week 5:	Crystal Systems and space groups	
Week 6:	X-ray interactions with materials .....	<b>Quiz: crystallography (Tu)</b>
Week 7:	Powder diffraction	
Week 8:	Review (Tu) .....	<b>Exam 1 (Th)</b>
Week 9:	spring break	
Week 10:	Phase identification from powder data	
Week 11:	Structure and refinement .....	<b>Quiz: Powder diffraction (Tu)</b>
Week 12:	Thin films and single crystal XRD	
Week 13:	GIXRD/XRR techniques	
Week 14:	Pole figures, stress, RSM	
Week 15:	XRF techniques .....	<b>Quiz: thin film techniques (Tu)</b>
Week 16:	CT scanning techniques (Tu only, Th reading day)/ Corresponding Book Chapters	

**Final exam Scheduled for: May 1<sup>st</sup> 2019 @ 10:00am-12:00pm**

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

Students are expected to attend class as scheduled. There will be a sign in sheet available or students will be asked to submit a short answer in lieu of a sign in sheet. Full attendance credit will be given to students who attend a minimum of 26 of the 29 scheduled meetings; 5% of the attendance grade will be lost for additional absences. Electronic devices can be powerful learning tools; however, students should avoid the distraction of social media and unrelated web activities while in class. Phones should be placed in silent mode or powered off to reduce class disturbances. Missed quizzes and exams will only be allowed for excused absences. Excused absences must be consistent with university policies in the Graduate Catalog. Although course materials should be posted to the course webpage, this should not serve as a substitute for attending class. Reminder, the 12-day rule for university sponsored activities requires advanced notice.

(<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance>) and require appropriate documentation. Additional information can be found here:

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

***Evaluation of Grades: Individual progress can be monitored on the course website.***

Assignment	Percentage of Final Grade
Attendance	10%
Quizzes (4)	30%
Midterm Exam	30%
Final Exam	30%
Course total:	100%

### **Grading Policy**

<b>Percent</b>	<b>Grade</b>	<b>Grade Points</b>
90.0 - 100.0	A	4.00
87.0 - 89.9	A-	3.67
84.0 - 86.9	B+	3.33
81.0 - 83.9	B	3.00
78.0 - 80.9	B-	2.67
75.0 - 79.9	C+	2.33
72.0 - 74.9	C	2.00
69.0 - 71.9	C-	1.67
66.0 - 68.9	D+	1.33
63.0 - 65.9	D	1.00
60.0 - 62.9	D-	0.67
0 - 59.9	E	0.00

More information on UF grading policy may be found at:

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

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

### **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/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.

### **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: <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>.