

X-Ray Methods for Material Characterization
EMA 6516 || Sections 13136, 13137, 13134, 13135
Class Periods: MWF || Period 8 (3:00 PM - 3:50 PM)
Location: Hybrid/Edge. Classroom is CSE E118
Academic Term: Spring 2022

Professor: Megan Butala (she/her)
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Office Hours: TBD

Course Description

Provides an introduction to the principles and methods of materials characterization using X-rays and their various interactions with matter. The course will focus primarily on diffraction and scattering techniques from a crystallography perspective (we'll discuss the application to powders, especially, and thin films).

Course Objectives

This course serves as an introduction to foundations of X-ray characterization, data interpretation, and data analysis. We will discuss the theory of the techniques, as well as their application, across fields as well as from literature and the research subjects of enrolled students.

Required Textbook

Elementary Scattering Theory

Author: D. S. Sivia

ISBN: 9780199228683

*Available as e-book through the library/Course reserves

Other texts that I may source content from:

The Basics of Crystallography and Diffraction

Author: C. Hammond

ISBN: 9780199546459

X-ray Structure Determination

Author: G. H. Stout and L. H. Jensen

ISBN: 9780471607113

Additional and supplementary content (reading, videos, and other resources) will be updated throughout the semester and provided through Canvas or course lectures.

Please reach out for specific subjects and/or very affordable text options.

Anticipated Course Schedule (tentative and subject to change, Monday dates)

Week 1: (1/5)	Introduction to X-ray Characterization, History and Overview
Week 2: (1/10)	Crystallography I [Holiday Monday 1/10]
Week 3: (1/17)	Crystallography II
Week 4: (1/24)	Student Presentations: Applications of X-ray methods / Scattering I
Week 5: (1/31)	Scattering II
Week 6: (2/7)	Wrap up, Review, Exam 1
Week 7: (2/14)	Guest topics / Diffraction I
Week 8: (2/21)	Guest topics / Diffraction II (reciprocal space)
Week 9: (2/28)	Diffraction III / Student Presentations: Specialty technique
Week 10: (3/7)	<i>Spring Break</i>
Week 11: (3/14)	Powder XRD and Data Analysis I

Week 12: (3/21)	Powder XRD and Data Analysis II
Week 13: (3/28)	Wrap up, Review, Exam 2
Week 14: (4/4)	Special Cases in Powder XRD, and related characterization methods
Week 15: (4/11)	Practical applications and project – Term paper due
Week 16: (4/18)	Practical applications and project – Peer evaluations of term paper

Lectures & Office Hours

Lectures will be recorded and accessible through Canvas. We will adapt as needed for pre-recorded vs. synchronous options.

A recommendation: Research shows students learn and retain information best taking notes by hand (see [Scientific American: A Learning Secret - Don't take Notes with a Laptop](#)). In Office Hours, we may use cell phones or websites to conduct real time polling or interactive content, but it is in your best interest to put your phone away, turn off notifications on your computer and email, and close irrelevant windows when watching lectures or participating in a group setting for this class.

Privacy Information for Synchronous Sessions (Lectures and/or Office Hours)

Our Zoom sessions may be audio visually recorded for students in the class to refer to later and for enrolled students who are unable to attend live sessions. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If a Zoom call is being recorded, you will see an indication of this in the window. 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 during recording, which allows students to type questions and comments live. As in all courses, unauthorized recording and/or sharing of recorded materials is prohibited.

Attendance Policy and Make-Up Policy

Any persistent and disruptive behavior in group sessions will result in the student being removed from the virtual or physical classroom and, depending on the nature of the behavior, reported to the department, college, or university for misconduct.

Synchronous attendance will not be required for this class, but will be offered for working through examples and for applied/workshop using software or on presentation/project preparation. There will still be set due dates for assignments and exams, though this will be submitted electronically through Canvas. Failure to submit assignments and exams on time will result in a loss of credit, up to zero points for the assignment.

Generally, at least one week in advance notice is required for assignment or exam extension requests. In accordance with university attendance policy, acceptable reasons for absence from or failure to participate in class include illness, serious family emergencies, special curricular requirements, military obligation, severe weather conditions, religious holidays, and participation in official university activities such as music performances, athletic competition or debate. Absences from class for court-imposed legal obligations (e.g., jury duty or subpoena) must be excused. Other reasons also may be approved. Please note that assignment deadlines for other courses will not be considered. Students who do not follow the approved procedure and timeliness for an assignment or exam will receive a score of zero.

Class Expectations

Contacting the Professor: Students should use Canvas to contact me. While you may email me at my UF email account, the university strongly encourages we communicate via Canvas to avoid the potential of violations of

student confidentiality protected by [FERPA](#). I strongly encourage students to attend virtual office hours (or schedule a meeting) to discuss any questions or concerns regarding the course.

Messaging/Email Hours: You may contact me via Canvas or email at any time that is convenient to you. I will respond within one business day between the hours of 8:30 AM and 5:30 PM. If you do not receive a reply from me after 48 hours, please resend your message. Although I may sometimes reply outside of these designated hours, responses cannot be guaranteed after 5:30 PM on weekdays, on weekends, or on academic holidays. Please plan accordingly to have your questions answered in advance of assignment and exam deadlines.

Interpersonal Conduct: Mutual respect for your classmates, the professor, and yourself is expected in all communication; all class members are expected to treat each other at all times with respect, courtesy, tolerance, fairness, and justice. As we navigate the virtual setting, we'll all need to work together patiently and establish trust (including academic integrity).

Effort: The university recommends that students typically spend 9 to 12 hours per week for a 3-credit class. This can of course vary, but is a good initial guideline as the term begins.

Recommendations for the Virtual Classroom: Set boundaries you need to so you can focus in class: use headphones; tell roommates you're "in class"; and quiet audio and visual distractions from other electronics, books, and pets (as feasible). Consider getting ready as though you're going to a physical class, perhaps this can help you focus? Try it out and, generally, **take ownership of your learning experience**.

Recommendations for This Classroom: For lectures, assignments, quizzes, and exams, it is in your best interest to ask questions or for clarification when content or a prompt is not making sense so that we can review it or I can change my approach.

Referencing the Professor: Often, students have questions over proper naming or titling etiquette for communicating with their professors. As this is primarily a graduate-level class, I invite you to use my first name, but you may use any of the following: Megan, Dr. Butala, Dr. B, Professor Butala, or Professor B.

Evaluation of Grades

Assessment	Percentage of Final Grade
Exams (2)	30% total (15% each)
Term 'paper'	20%
Presentations (2)	20%
Homework	10%
Quiz-lets	10%
Group conduct & participation	10%

Exams: There will be 2 exams with explicit timing, resource, and collaboration instructions, but will need not be taken at a specific time and will not make use of proctoring services. There will be no Final Exam.

Homework: Homework must be submitted through Canvas. Email is not acceptable for submission of homework, nor will physical copies be accepted.

Quiz-lets: Periodic quiz, question, or discussion prompt will be posted in Canvas. These serve to help you stay on track with course timing and content. These are to be completed individually with no collaboration.

Groups: To facilitate a sense of community, develop skills working in teams, and allow more interaction with course content, you will be assigned groups that are expected to meet for a minimum of 1 hour per week for the semester. It is up to the group how you choose to spend this hour and when you meet, but I recommend using it to discuss

lectures, homework, and any other course content. You will also on occasion be asked to work together on assignments. Additionally, groups will provide feedback on each member's engagement, contributions, focus, and conduct, which will be reflected in the group work grade. This is an opportunity for you to practice interacting with the course content as well as to build your professional communication skills and network.

In doing this, also consider how you can design a group dynamic that facilitates participation: develop group norms and expectations, reflect and check-in about how you're all working together, and foster a team environment where you're all helping one another to succeed. Perhaps establish in the first couple of weeks a grading rubric for your team.

Grading: Grades will be based on your understanding and mastery of the material as assessed by a term paper, two presentations, exams, homework, weekly content checks, and group contributions. Late assignments or exam will only be eligible for reduced credit, up to a reduction to zero credit.

You have one week after an exam, homework, or other assignment is returned to resolve any question about scores or grades. No changes to your assessment grades will be made after that time.

Grading Policy

Percentage	≥ 93	≥ 90	≥ 87	≥ 83	≥ 80	≥ 77	≥ 73	≥ 70	≥ 67	≥ 63	≥ 60	< 60
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.*

More information on UF grading policy may be found at:

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

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.ua.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.ua.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 or TA in this class.

Violations of the honor code include, but are not limited to, plagiarism (intentional or unintentional), cheating, unauthorized collaboration and misrepresenting of any work that isn't yours as your own. Any violation of the honor code will result in academic sanctions and further disciplinary action.

If you are uncertain of the policy for collaboration or use of resources (textbook, web, etc.) on an assignment, exam, or quiz, please ask the instructor well-ahead of the deadline for the assessment.

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
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, 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:

Accessibility Services / 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.

Technology Resources

The entirety of our course will take place virtually, requiring the use of a working computer and access to audio-visual resources (webcam, microphone, speakers). If you are struggling to use Zoom or Canvas, please review these [UF Quick Start guides](#). This [link](#) also connects to UF resources regarding internet connectivity.

The UF Computing Help Desk can assist you with any of your technical issues. You can access the Help Desk 24/7 at <https://helpdesk.ufl.edu/>, 352-392- HELP (4357), or helpdesk@ufl.edu. If you use email, write from your gatorlink@ufl.edu email address, or include your UFID and/or GatorLink username (NOT your password!) in the body of the email. Provide complete information regarding the course and content to which you are referring.

Financial and COVID Related Services

In case of emergency financial need, UF's Aid-a-Gator program provides students with emergency funding: <https://www.sfa.ufl.edu/aidagator/>. The program is intended to "help our students need to cover costs related to unanticipated travel, additional technology requirements, or other needs related to an emergency situation."

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 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: <https://counseling.ufl.edu>, 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

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) 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://career.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://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>; <https://care.dso.ufl.edu>.

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

Additional Resources

If you or someone you know is struggling with any crisis including but not limited to gender, sexual, racial, or domestic violence, there are many community and University of Florida resources available. Some of these include:

- *RESPECT – UF Division of Student Affairs* (respect.ufsa.ufl.edu)
- *Student Health Care Center* (352-392-1161, shcc.ufl.edu)
- *Multicultural & Diversity Affairs* (352-392-1217, multicultural.ufl.edu)
- *UF Health Shands Emergency Room / Trauma Center* (352-733-0111)
- *Gainesville Police Department* (non-emergency #: 352-955-1818, gainesvillepd.org)

While faculty and staff in our department are also resources for you, please keep in mind some of us (including me) are [Title IX mandatory reporters](#).