

X-Ray Methods for Material Characterization
EMA 6516 || Sections 11997, 11998, 11999, 12000, 26003
Class Periods: MWF || Period 8 (3:00 PM - 3:50 PM)
Location: Hybrid/Edge. Classroom is MAEB 229
Academic Term: Spring 2025

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

Elementary Scattering Theory

Author: D. S. Sivia

ISBN: 9780199228683

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.

Required Computer

UF student computing requirement: <https://news.it.ufl.edu/education/student-computing-requirements-for-uf/>

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

Week 1: (1/13)	Introduction to X-ray Characterization, History and Overview, begin Crystallography
Week 2: (1/20)	Crystallography cont. [Holiday Monday 1/20]
Week 3: (1/27)	Crystallography cont., Project 1 Introduction
Week 4: (2/3)	Scattering
Week 5: (2/10)	Guest Lectures and Exam 1
Week 6: (2/17)	Scattering cont.
Week 7: (2/24)	Scattering cont.
Week 8: (3/3)	Guest Lectures and Project 2 Introduction
Week 9: (3/10)	Powder XRD
Week 10: (3/17)	<i>Spring Break</i>
Week 11: (3/24)	Powder XRD cont.
Week 12: (3/31)	Data Analysis
Week 13: (4/7)	Data Analysis cont.
Week 14: (4/14)	Special Cases / Exam 2

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)

Any Zoom-based office hour or lecture periods 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 unmute 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 through the appropriate Canvas assignment on time will result in a loss of credit, up to zero points for the assignment.

Generally, at least one week advanced notice is required for assignment or exam extension requests. In accordance with university attendance policy, acceptable reasons for not participate in course activities 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.

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/>

Class Expectations

Contacting the Professor: Students should use Canvas to contact me about course business. 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 on weekdays after 5:30 PM, 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.

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 Course: For lectures, assignments, quizzes, and exams, it is in your best interest to ask questions or for clarification well ahead of the deadline 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. You may use any of the following: Dr. Butala, Dr. B, Professor Butala, or Professor B.

Evaluation of Grades

Assessment	Percentage of Final Grade
Exams (2)	40% total (20% each)
Project 1 (Presentation)	15%
Project 2 (Term Paper)	20%
Homework	10%
Quizzes	10%
Group conduct & participation	5%

Exams: There will be 2 exams with explicit timing, resource, and collaboration instructions, but will not need be taken at a specific time. There will be no Final Exam. Instances in which it appears that disallowed resources were used will be reported.

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

Quizzes: 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 academic 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 work together on assignments,

including projects. 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. Unexcused late submissions of any assignment or exam will result in reduced credit, up to a reduction to zero points.

You have one week after an exam, homework, or other assignment is returned to resolve any questions 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:

[UF Graduate Catalog](#)
[Grades and Grading Policies](#)

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/>.

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.

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/process/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 TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values varied perspectives and lived experiences within our community and is committed to supporting the University’s core values, including the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of race, creed, color, religion, age, disability, sex, sexual orientation, gender identity and expression, marital status, national origin, political opinions or affiliations, genetic information, and veteran status.

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 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
- 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:

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/>.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.
<https://elearning.ufl.edu/>.

Career Connections 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: <https://distance.ufl.edu/getting-help/>; <https://distance.ufl.edu/state-authorization-status/#student-complaint>.

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:

- *Student Health Care Center* (352-392-1161, shcc.ufl.edu)
- *Multicultural & Diversity Affairs* (352-392-1217, multicultural.ufl.edu)
- *UF Office of the Ombuds* (352-392-1308, <https://www.ombuds.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](#).