MSE 481 SYLLABUS

INSTRUCTOR: Pinshane Huang (office: MRL 258, email: pyhuang@illinois.edu)
LOCATION: 2:00 - 2:50 M,W,F 305 MSEB
OFFICE HOURS: 3:00-4:00 PM Wednesday in MRL 258, or by appointment

COURSE DESCRIPTION: This 3- or 4-credit course focuses on transmission electron microscopy, one of the most powerful and flexible tools to understand materials. The course will cover both theory and practical concepts, and work to build intuition for transmission electron microscopy. We will cover the basic operating principles of the microscope, the physics of electron diffraction and image formation, data interpretation, and electron microscopy experiment design.

COURSE OBJECTIVES: Enable students to…
- Understand the optical components of a TEM
- Describe and predict electron scattering in solids
- Interpret diffraction patterns
- Interpret images including bright and dark field TEM, HRTEM, and STEM
- Understand the key concepts in advanced TEM techniques including EELS, tomography, high-resolution TEM, X-ray microanalysis, and identify appropriate applications, advantages, and limitations of each technique
- Design a TEM experiment: evaluate which samples can be examined and what can be learned about them, chose which TEM techniques are appropriate, describe what the TEM data might look like and how to interpret it in terms of the experimental goals
- Describe modern TEM experiments and the frontiers of TEM

WHO SHOULD TAKE THIS COURSE: In general, this course can be taken by any senior-level undergraduate or graduate student who is interested in learning about electron microscopy. This course is often elected by students who incorporate TEM into their research and would like to develop a theoretical background for their work. In the MatSE department, this course may be taken in preparation for the Qualifying Exam on Electron Microscopy and Diffraction.

PREREQUISITES: Undergraduates should have taken MSE 405 (Microstructure Determination) or equivalent. This course assumes basic undergraduate-level understanding of electromagnetism, quantum mechanics, and crystal structures. Also useful: solid state physics and Fourier transforms.


*** This text is available free as an e-book through the University Library. This is a great reference, and I would recommend buying a softcover copy of the text, for $25 through Springer. To access the book, search "Williams and Carter" at the library website. Go to the heading “Ebooks by Title and Chapter”, then click “Springer Ebooks”. This should take you to the Springer site; find the Second Edition, which is light blue. Many of the suggested references are available this way as well. ***
OTHER RECOMMENDED REFERENCES: (available online or as course reserves)

EXPECTATIONS: This course is geared toward teaching you as a scientist to utilize the concepts of electron microscopy to empower your research. As much as possible, this course is built around inquiry-based learning rather than memorization. I want you to know why, not just what. Interactivity in and out of class is important. If you don’t understand something, or the problem sets are unreasonably difficult, please tell me. You are expected to read the assigned text before coming to class. Our class lectures are designed to complement, not substitute for the readings, and will generally be at a higher level than the textbook.

COURSE MATERIALS: Course materials, including hand-outs and problem sets will be available online through our course Compass website.

PROBLEM SETS: Problem sets will be due on Thursdays at 5 pm, in our course homework mailbox, which a gray lockbox is located on the Second Floor MSEB lounge (MSEB 216B). You will be issued one Late Homework Coupon, which can be stapled to and turned in along with one homework set for a 24-hour extension. Late homework should be placed in the homework box. Otherwise, late problem sets will not be accepted without permission from the instructor. You are encouraged to collaborate and seek help. But, your write-ups must be in your own words, not copied or paraphrased from your classmates or any other sources. You must acknowledge in writing anyone who you talked to or worked with in order to complete your work.

GETTING HELP: I strongly encourage you to work with your classmates and peers. I will also hold weekly office hours from 3:00-4:00 PM Wednesday in MRL 258, where you can bring any questions you have about the course or electron microscopy in general.
ACCOMMODATIONS:
To obtain disability-related academic adjustments and/or aids, students should contact the course instructor and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, you may visit 1207 S. Oak St., Champaign, e-mail disability@illinois.edu, or go to the DRES website. If you are concerned you have a disability related condition that is impacting your academic progress, academic screening appointments are available on campus that can help diagnose a disability.

ACADEMIC INTEGRITY:
Honesty and integrity are fundamental to our community. Guidelines for academic integrity are detailed in Article 1, Part 4 of the Illinois Student Code. Any confirmed violations of that code will be taken seriously and may result in failure for the course.

3 VS 4 CREDIT HOURS: Students have the option of taking this course for either 3 or 4 credit hours. The 4-credit option for graduate students is designed to incorporate applied skills and a stronger research focus. Students enrolled for 4 credit hours will be required to complete ~1 additional problem on each problem set, and complete the final project. Applied problems are typically exercises in data simulation or analysis; they will be graded for completion only. You should consider taking the 4-credit option if some of the following apply to you:

- You plan to use electron microscopy heavily in your own research
- You want to maximize connections between what we are learning in the classroom and the real-world use of a TEM
- You enjoy a more in-depth and interactive learning experience
- You are just curious and would like to know more about the TEM

I will not sign credit hour changes after the course add/drop deadline.

EVALUATION: (3) OR [4] CREDITS
Problem sets (40%) [35%]
Exam 1 (30%) [25%]
Exam 2 (30%) [25%]
Final project (0%) [15%]