

MSE 6741 Syllabus

Objective:

The object of this course is to teach you practical aspects of TEM operation. There will be a lecture/demonstration and a 3 hour laboratory per week. Topics will include

- Operation and alignment of the TEM
- Calibration of and the TEM
- Electron Diffraction
- Bright Field, Dark Field, and STEM imaging.
- X-ray analysis in the TEM.

Grading:

Grading is based on lab reports that you will write during the course and on a practical exam at the end of the term. The practical exam counts the same as one lab report. Unexcused class absences will factor into the grade. Late reports will also receive a grade penalty.

The laboratory notebook should be a record of all your observations during the lab sessions as well as **discussion of your results**. Photomicrographs and diffraction patterns should be printed and included in your notebooks/reports and sized so as to be legible. You must include all your data so that we can follow your analysis. You may share the micrographs of your lab session with your partners, but you are expected to write the lab report individually. Lab reports are due one week after the lab. In any event, lab reports will not be accepted any later than 5:00 pm on the final day of class. You may practice for the practical exam any time after the last lab has finished. It is your responsibility to contact me to schedule your practical. It may be scheduled any time before the end of finals.

Assumed Knowledge:

You should have some knowledge of elementary crystallography and reciprocal lattice construction. You should understand Bragg's Law and the Ewald sphere construction. You can find a good introduction to the TEM at <http://www.materials.ac.uk/elearning/matter/>. There is also a somewhat simpler introduction to TEM at the MyScope site (<http://www.ammrf.org.au/myscope/>).

Tentative Schedule (subject to revision)

The lab times will be arranged individually with the TA.

Week	Date	Lab	Topics
1	1/8/19	Basic operation I	SEM vs. TEM, identification of column parts, gun operation, saturation, gun tilt/trans, condenser aperture, condenser stigmation
2	1/15/19	Basic Operation II	Eucentric height, rotation center, objective aperture, focus (grain, fresnel fringes), Objective stigmation.
3	1/22/19	Basic Operation III	Digital camera basics, taking photos, exposure, magnification calibration, sample exchange
4	1/29/19	Diffraction	Polycrystal/single crystal, Braggs Law (small angle), Selected area diffraction, reciprocal lattice, camera length calibration, microscope effect on diffraction

5	2/5/19	BF/DF/ single crystal diffraction	Bright Field, Dark Field imaging, objective aperture size consideration (contrast vs. resolution), on-axis vs. off-axis DF
6	2/12/19	STEM	Scanning Transmission EM, BF/DF, HAADF
7	2/19/19	EDX	TEM vs SEM EDX, acquisition & quantification issues, Cliff-Lorimer method, absorption, k-factor calculation
8	2/26/19	Sample Prep	Sample Prep overview
			Practical Exam (individually scheduled)

Semester Holidays: MLK Day (Jan 21), Spring Break (Mar 11-15),

Last Day of classes: April 22, 2019

Semester Final Exams: April 24-30, 2019

For interested students, I will do an optional lab on Kikuchi lines, sample tilting, and diffraction pattern indexing. This is optional and ungraded.

References:

- D.B. Williams and C.B. Carter, *Transmission Electron Microscopy: A Textbook for Materials Science*, Plenum, 2nd edition (2009)
- J.W. Edington, *Practical Electron Microscopy in Materials Science*, Tech Books, Inc., 4012 Williamsburg Court, Fairfax, VA 22032, 703-352-0001, fax 703 352 8862
- P. Hirsch, A. Howie, R.B. Nicholson, D.W. Pashley, M.J. Whelan, *Electron Microscopy of Thin Crystals*, R.E. Krieger, 1977.
- <http://www.materials.ac.uk/elearning/matter/>
- <http://www.ammrf.org.au/myscope/>

Academic Misconduct

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the [Code of Student Conduct](http://studentconduct.osu.edu) at <http://studentconduct.osu.edu>

Disability Services

Students with disabilities that have been certified by the Office for Disability Services will be appropriately accommodated and should inform the instructor as soon as possible of their needs. The Office for Disability Services is located in 098 Baker Hall, 113 W. 12th Avenue; telephone 292-3307, TDD 292-0901, VRS 429-1334; <http://www.ods.ohio-state.edu/>.

Contact info:

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