

Analytical Methods for Materials: MTE 481 (W) FALL SEMESTER

Catalog Description:

- ★ Crystallography, physics of X-rays, diffraction by crystalline materials, applications of X-ray and electron diffraction, and spectrometric analysis of materials. 3 hours.

Prerequisite:

- ★ MTE 271 and 373 or permission of instructor.

Instructor:

- ★ Dr. Mark L. Weaver, Rm. A101 Bevill, 348-7073, mweaver@eng.ua.edu

Office Hours:

- ★ MW 3:00 PM – 4:00 PM or by appointment.

Lecture Times:

- ★ TR 3:30 PM – 4:45 PM

Laboratory Times:

- ★ M-F as scheduled by lab groups and the instructor

Lab Instructor(s):

- ★ T.B.A.

Recommended Text(s):

- ★ *Microstructural Characterization of Materials*, by David Brandon and Wayne D. Kaplan. This text is available as an e-book via the UA libraries on-line catalog.

Course Objectives:

- ★ Students will learn how to characterize the microstructures of materials using traditional analytical experimental techniques. Topics include the use of X-rays, and electron beams to characterize the chemistry and crystallography of materials.

Exams:

- ★ Two closed book in class examinations: 200 points each.
- ★ One cumulative take-home final examination: 150 points.
- ★ Students will be allowed to bring in one 8.5 × 11 hand written sheet to the in class exams.

Homework:

- ★ Homework assignments and quizzes will occasionally be given. They will only be graded on a +/- system. They are intended to reinforce your knowledge and to introduce you to my method of questioning. Late homework assignments will not be accepted or graded.

Laboratories:

- ★ During the course of the semester students will conduct a series of laboratory exercises. These laboratories are designed to teach you how to characterize real materials using valid experimental techniques. **All laboratory exercises are mandatory.**
- ★ Most laboratories will need to be completed outside of the scheduled class periods. Scheduling and completing them will be the responsibility of the lab groups.
- ★ **Written lab reports are required for each laboratory.** All lab reports will conform to the MTE 481 laboratory template supplied by the instructor. All reports shall be individual except the final laboratory project.
- ★ A group report shall be prepared for the final project. The final laboratory project shall be accompanied with a brief, 15-20 minute, oral presentation of the results. This presentation shall be give by the group. As this course as a “W” designation, **writing proficiency is required of students who desire to receive a passing grade.** Students must demonstrate the ability to write coherent, logical, properly edited sentences.

Each lab report will be graded on a 0 to 100 point scale. At the end of the semester all of the lab scores will be summed and normalized to 300 points and applied to determine your final point percentage.

- ★ The final group projects will be worth 150 points.
- ★ **Failure to complete all written lab reports and the final lab project will result in a failing grade for the course.**

Point Distribution:

Object/Activity	Values	Points	Percentage
In class exams	2 exams @ 200 points each	400	40.0%
Final examination	150 points	150	15.0%
Lab reports	At least 5 labs @ (300/n*) points each	300	30.0%
Final lab project	Group report & presentation	150	15.0%
Total	1000 points	1000	100.0%

n* = total # of labs

Grading Scale:

	A+	≥ 95%
90% ≤	A	< 95%
87% ≤	A-	< 90%
84% ≤	B+	< 87%
80% ≤	B	< 84%
77% ≤	B-	< 80%
74% ≤	C+	< 77%

70% ≤	C	< 74%
67% ≤	C-	< 70%
64% ≤	D+	< 67%
60% ≤	D	< 64%
57% ≤	D-	< 60%
57% <	F	

Class Policies:

- ★ **Attendance at examinations and laboratories is mandatory.** If you must miss a scheduled laboratory or examination due to serious illness, family death, accident, etc., notify Professor Weaver or the department office as soon as possible. Excuses of a non-urgent nature will not be accepted.
- ★ Late lab reports will be penalized 10% of the full value for each day or partial day past due up to a limit of 50%. Lab reports will not be accepted if they are more than 5 days late. Homework assignments will not be accepted if they are late.

Makeup Classes:

- ★ My busy travel schedule will make it necessary for us to schedule several makeup classes throughout the semester. They will generally be scheduled for Monday, Wednesday, Friday or Saturday afternoons. Makeup lectures will be announced in class.

Students with Disabilities:

- ★ To request disability accommodations, please contact disability services. After initial arrangements are made with that office, contact your instructor with the proper University forms from the disability services

Office of Disability Services
 133B Martha Parham East
 Box 870185
 Tuscaloosa, AL 35487-0185
 Phone: (205)348-4285
 TTY: (205)348-3081
 Fax: (205)348-0804

Course Web Site:

- ★ Some course materials will be posted on the course web site following the lecture in which they were presented. (<http://bama.ua.edu/~mweaver/mte481.htm>)
- ★ Check the web site frequently as materials will be updated during the semester.

Course Content **(Tentative List)***

- 1) Introduction to Materials Characterization
- 2) Crystallography
- 3) Fundamentals of Diffraction
- 4) X-ray Diffraction
- 5) Light Optical Microscopy
- 6) Transmission Electron Microscopy (TEM)
- 7) Scanning Electron Microscopy (SEM)
- 8) Electron Probe Microanalysis, i.e., electron microprobe (EPMA)
- 9) Chemical Analysis in the SEM (EDS, WDS)
- 10) Chemical Analysis in the TEM (EDS, EELS)
- 11) Surface Analysis: XPS, AES
- 12) Scanning Probe Microscopy (AFM, STM, etc.)
- 13) Surface Analysis: SIMS, RBS
- 14) Practical Applications of Experimental Methods (Lectures, Labs, and Demonstrations)
 - a) Basic metallography and optical microscopy
 - b) Crystal structure determination via XRD for cubic crystals
 - c) Crystal structure determination via XRD for non-cubic crystals
 - d) Lattice parameter determination via XRD and application for phase diagram determination
 - e) Determination of long-range ordering via XRD
 - f) Crystal size and lattice strain via XRD
 - g) Quantitative analysis of mixtures via XRD and electron microscopy
 - h) Surface analysis of materials via XPS
 - i) Complete identification of unknowns via XRD and electron microscopy
- 15) Technical Writing

* The instructor reserves the right to alter this list at any time due to time constraints, equipment availability, or other extenuating circumstances.