

**The University of Texas at Arlington
Materials Science and Engineering Department**

MSE 5390-002 / 4390-001 *Special Topics in Materials Science and Engineering*

Instrumentation for Materials Characterization

Summer 2016

Jun 6, 2016 - Aug 11, 2016

Instructor(s): Jiechao Jiang

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Faculty Profile: <https://mentis.uta.edu/public/#profile/profile/edit/id/1464/category/3>

Office Hours: Monday & Wednesday: 2:00-3:00 pm

Lecture Meetings: Tuesday: 1:00 pm - 2:50pm, WH 210

Lab: Monday/ Wednesday: 9:30 am - 12:30pm, ELB 104 (GS 233)

Description of Course Content: This course is composed of two components: lecture and laboratory for several materials characterization techniques. The lecture part includes the instruction of basic principles and theories behind AFM, Raman, FT-IR, XRD, SEM, TEM and spectroscopic techniques. Students in the class are divided into small groups for the laboratory part (4 – 5 people per group) so that students can gain hand-on experiences on various characterization techniques by operating associated equipment.

Student Learning Outcomes:

- To learn basic principles for spectroscopic techniques including Raman, FT-IR, EDS, XPS/AES.
- To gain basic crystallography knowledge, principles for x-ray diffraction and electron diffraction.
- To understand principles for AFM, SEM, TEM; to acquire good imaging skills and experience for operating associated instrumentation to acquiring high-quality AFM, SEM and TEM images.
- To learn to acquire bright-field, dark-field and high-resolution TEM images and electron diffraction patterns.
- To learn to apply a right technique to solve the problems in materials researches.

Project: One project will be given during the semester. This project involves selection of specific topic or problem, extensive literature review and analysis with a view to exhibit mastery over the subject, selection of techniques, instrumentation operation and data analysis. A report for this project is required.

Examinations: One mid-term (about middle of the semester) and a final examination (both close notes)

Emergency Phone Numbers: In case of an on-campus emergency, call the UT Arlington Police Department at **817-272-3003** (non-campus phone), **2-3003** (campus phone). You may also dial 911. Non-emergency number 817-272-3381

Required Textbooks and Other Course Materials:

1. Yang Leng, **Materials Characterization Introduction to Microscopic and Spectroscopic Methods**, John Wiley and Sons (Asia) Pte Ltd, Publication (2008) (ISBN: 9780470822982)
2. Joseph Goldstein, Dale Newbury, David Joy, Charles Lyman, Patrick Echlin, Eric Lifshin, Linda Sawyer and Joseph Michael, **Scanning Electron Microscopy and X-ray Microanalysis**, Springer (2003) (ISBN: 0-306-47292-9)
3. David Bernard Williams, C. Barry Carter, **Transmission Electron Microscopy**. Springer Science & Business Media, 1996

Attendance:

Lecture attendance and laboratory session participation will be taken as points in the final grade. Students are allowed to miss up to 1 lecture session with a valid excuse without deducting points.

Grading Basis:	Lecture attendance	5%
	Laboratory session participation	5%
	Project (report):	35%
	Midterm Exam:	25%
	Final Exam:	30%

Grading Policy: $\geq 85\%$: A; 75-85%: B; 60-74%: C; 50-59%: D; $< 50\%$: F

Expectations for Out-of-Class Study: Beyond the time required to attend each class meeting, students enrolled in this course should expect to spend at least an additional **6** hours per week of their own time in course-related activities, including reading required materials, carrying out labs for project, preparing for project report and exams.

Drop Policy: Students may drop or swap (adding and dropping a class concurrently) classes through self-service in MyMav from the beginning of the registration period through the late registration period. After the late registration period, students must see their academic advisor to drop a class or withdraw. Undeclared students must see an advisor in the University Advising Center. Drops can continue through a point two-thirds of the way through the term or session. It is the student's responsibility to officially withdraw if they do not plan to attend after registering. **Students will not be automatically dropped for non-attendance.** Repayment of certain types of financial aid administered through the University may be required as the result of dropping classes or withdrawing. For more information, contact the Office of Financial Aid and Scholarships (<http://www.uta.edu/aao/fao/>).

Disability Accommodations: UT Arlington is on record as being committed to both the spirit and letter of all federal equal opportunity legislation, including *The Americans with Disabilities Act (ADA)*, *The Americans with Disabilities Amendments Act (ADAAA)*, and *Section 504 of the Rehabilitation Act*. All instructors at UT Arlington are required by law to provide "reasonable accommodations" to students with disabilities, so as not to discriminate on the basis of disability. Students are responsible for providing the instructor with official notification in the form of a letter certified by the **Office for Students with Disabilities (OSD)**. Students experiencing a range of conditions (Physical, Learning, Chronic Health, Mental Health, and Sensory) that may cause diminished academic performance or other barriers to learning may seek services and/or accommodations by contacting:

The Office for Students with Disabilities, (OSD) www.uta.edu/disability or calling 817-272-3364.
Counseling and Psychological Services, (CAPS) www.uta.edu/caps/ or calling 817-272-3671.

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Only those students who have officially documented a need for an accommodation will have their request honored. Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at www.uta.edu/disability or by calling the Office for Students with Disabilities at (817) 272-3364.

Title IX: *The University of Texas at Arlington does not discriminate on the basis of race, color, national origin, religion, age, gender, sexual orientation, disabilities, genetic information, and/or veteran status in its educational programs or activities it operates. For more information, visit uta.edu/eos. For information regarding Title IX, visit www.uta.edu/titleIX.*

Academic Integrity: Students enrolled all UT Arlington courses are expected to adhere to the UT Arlington Honor Code:

I pledge, on my honor, to uphold UT Arlington's tradition of academic integrity, a tradition that values hard work and honest effort in the pursuit of academic excellence.

I promise that I will submit only work that I personally create or contribute to group collaborations, and I will appropriately reference any work from other sources. I will follow the highest standards of integrity and uphold the spirit of the Honor Code.

UT Arlington faculty members may employ the Honor Code as they see fit in their courses, including (but not limited to) having students acknowledge the honor code as part of an examination or requiring students to incorporate the honor code into any work submitted. Per UT System *Regents' Rule* 50101, §2.2, suspected violations of university's standards for academic integrity (including the Honor Code) will be referred to the Office of Student Conduct. Violators will be disciplined in accordance with University policy, which may result in the student's suspension or expulsion from the University.

Lab Safety Training:

All students are required to take "x-ray radiation safety training" course.

Contact information:

Warren Laura
Safety Specialist (Radiation)
Phone: (817) 272-2185
E-mail: lwarren@uta.edu

Electronic Communication: UT Arlington has adopted MavMail as its official means to communicate with students about important deadlines and events, as well as to transact university-related business regarding financial aid, tuition, grades, graduation, etc. All students are assigned a MavMail account and are responsible for checking the inbox regularly. There is no additional charge to students for using this account, which remains active even after graduation. Information about activating and using MavMail is available at <http://www.uta.edu/oit/cs/email/mavmail.php>.

Student Feedback Survey: At the end of each term, students enrolled in classes categorized as "lecture," "seminar," or "laboratory" shall be directed to complete an online Student Feedback Survey (SFS). Instructions on how to access the SFS for this course will be sent directly to each student through MavMail approximately 10 days before the end of the term. Each student's feedback enters the SFS database anonymously and is aggregated with that of other students enrolled in the course. UT Arlington's effort to solicit, gather, tabulate, and publish student feedback is required by state law; students are strongly urged to participate. For more information, visit <http://www.uta.edu/sfs>.

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Final Review Week: A period of five class days prior to the first day of final examinations in the long sessions shall be designated as Final Review Week. The purpose of this week is to allow students sufficient time to prepare for final examinations. During this week, there shall be no scheduled activities such as required field trips or performances; and no instructor shall assign any themes, research problems or exercises of similar scope that have a completion date during or following this week *unless specified in the class syllabus*. During Final Review Week, an instructor shall not give any examinations constituting 10% or more of the final grade, except makeup tests and laboratory examinations. In addition, no instructor shall give any portion of the final examination during Final Review Week. During this week, classes are held as scheduled. In addition, instructors are not required to limit content to topics that have been previously covered; they may introduce new concepts as appropriate.

Emergency Exit Procedures:

Should we experience an emergency event that requires us to vacate the building, students should exit the room and move toward the nearest exit. When exiting the building during an emergency, one should never take an elevator but should use the stairwells. Faculty members and instructional staff will assist students in selecting the safest route for evacuation and will make arrangements to assist individuals with disabilities.

Course Schedule

- 1) Introduction to AFM: Contact mode and Non-Contact AFM;
- 2) Introduction to Nanoindentation and its application.
- 3) SEM: working principles, operation modes, instrumentation and performance, SEM imaging process, image formation and interpretation, imaging at high-resolution, low voltage, low-vacuum and electron backscatter imaging
- 4) Energy-dispersive spectroscopy (EDS): Theory and applications, Qualitative and Quantitative X-ray microanalysis.
- 5) Introduction to FTIR: theory, operation and application
- 6) Introduction to RAMAN spectroscopy: theory and application
- 7) X-ray Diffraction (XRD): theory, operation and data analysis.
- 8) TEM: Introduction to Transmission Electron Microscope, TEM sample preparation, Formation of images and electron diffraction patterns
- 9) Introduction to XPS and AES instrument and sample preparation, XPS and AES spectra acquisition and brief analysis of the spectra (demo).

Final Exams will be held on Monday, August 15, 2016, 9:30 am- 12:30 pm

“As the instructor for this course, I reserve the right to adjust this schedule in any way that serves the educational needs of the students enrolled in this course. – Jiechao Jiang.”