



Course	MSEN 3339.001
Course Title	Materials Characterization
Professor	Becca McClain
Term	Spring 2024
	Lecture: T/Th 1:00 – 1:50 PM, CB 1.202
Meetings	Lab: W 10:00 AM – 12:30 PM, RL 3.718 or W 2:30 PM – 5:00 PM, RL 3.718

I. Professor's Contact Information

Office Phone	(972) 883 – 5760
Office Location	RL 2.406
Email Address	Rebecca.McClain@UTDallas.edu
Office Hours	By appointment only.

II. General Course Information

Course Description:

This course focuses on techniques for solid-phase materials and emphasizes the practical applications of solid-phase materials characterization to address questions in areas ranging from art history to medicine to semiconductor wafers. Students will learn about spectroscopic, microscopic, diffraction, and thermal characterization methods as well as their associated error analyses.

Students will frequently work on individual and group activities to perform data analysis and to evaluate which technique(s) are best suited to address a given question. Laboratory work focuses on the design, construction, and use of instrumentation along with the interfacing of instruments and computers. The laboratory portion provides hands-on experience with select instruments at UTD's NSERL facilities.

Course Pre-requisites: CHEM 1311 or equivalent. MATH 2415 or MATH 2419 or equivalent. PHYS 2326 or PHYS 2422.

By the end of this course, students will be able to:

1. **Conduct** data analysis on spreadsheet software (e.g. Excel).
2. **Contrast** the discussed characterization methods, including what technical information they provide, their advantages, and their disadvantages.
3. **Propose and defend** which characterization method(s) are best suited to answering a given question concerning a material's properties.
4. **Operate** spectroscopic, microscopic, diffraction, and thermal instruments.
5. **Demonstrate** ability to research an unfamiliar instrument and report how it does its specified analysis/analyses.
6. **Incorporate** individual interests and interdisciplinary topics to materials science.

Recommended Texts & Materials:

Diffraction:

- Cullity, B. D., 2013. Elements of X-ray Diffraction 1 copy in course reserves at UTD
- Hammond, C., 2015. The Basics of Crystallography and Diffraction eBook at UTD (max 3 at a time): https://utdallas.primo.exlibrisgroup.com/permalink/01UT_DALLAS/16oidda/cdi_proquest_ebookcentral_EBC3564763

Electron Microscopy:

- Egerton R. F. 2016, Physical Principles of Electron Microscopy: An Introduction to TEM, SEM, and AEM
eBook at UTD: https://utdallas.primo.exlibrisgroup.com/permalink/01UT_DALLAS/2hg10t/alma9927677125601421
- Goldstein, J. I. et al, 2018, Scanning electron microscopy and X-ray microanalysis
eBook at UTD: https://utdallas.primo.exlibrisgroup.com/permalink/01UT_DALLAS/16oidda/cdi_scopus_primary_620859192
- Williams, David B ; Carter, C Barry, 2009, Transmission Electron Microscopy
eBook: https://utdallas.primo.exlibrisgroup.com/permalink/01UT_DALLAS/16oidda/cdi_proquest_ebookcentral_EBC3064417

III. Course Schedule and Deadlines

Week	Method	Lab Topics	Deadlines
1	Safety	BioRaft Safety: Time provided for completing safety training and confirm students have PPE	
2	Spectroscopy	Fourier Transform Infrared (FTIR) Spectroscopy	
3	Spectroscopy	Ultraviolet and Visible (UV-Vis) Spectroscopy	
4	Spectroscopy	Raman Spectroscopy	
5	Diffraction	X-ray Diffraction (XRD)	
6	Diffraction	X-ray Diffraction (XRD)	
7	Spectroscopy	X-ray Photoelectron Spectroscopy (XPS)	
8	Microscopy	Scanning Electron Microscopy (SEM)	
9		Spring Break	
10	Microscopy	Scanning Electron Microscopy (SEM)	Tues: Project Selection Tues: Report Topic Selection
11	Microscopy	Transmission Electron Microscopy (TEM)	Tues: Experimental Plan
12	Project	Independent Projects	
13	Project	Independent Projects	Tues: Report Outline
14	Probe	Atomic Force Microscopy (AFM)	Tues: Project PPT Draft
15	Thermal Analysis	Differential Scanning Calorimetry (DSC) and Differential Thermal Analysis (DTA)	Tues: Report Draft Thurs: PPT Peer Review
16	Check out	Laboratory check out	Tues or Thurs: Presentation Thurs: Report Peer Review

The topics and timelines are subject to change at the discretion of the Professor.

IV. Grading Criteria and Assessment Descriptions

Grading Scheme:

Assessment	Grade Percentage
Introductory Questionnaire	1%
Course Evaluation + Self-Reflection	1%
Pre-Lab Assignments (11 total, 1 dropped) <i>2% each</i>	20%
Post-Lab Assignments (11 total, 1 dropped) <i>3.5% each</i>	35%
Project: Topic Selection & Experimental Plan	3%
Project: Presentation and Speaker Note Draft	3%
Project: Peer Review of Presentation	5%
Project: Presentation	10%
Report: Outline	3%
Report: Full Draft	3%
Report: Peer Review of Draft	6%
Report: Final Report	10%

Details of Assessments and Evaluations:

Pre-Lab Assignments	<p>Each week students are expected to prepare for the lab by:</p> <p>A. Reading and understanding the experiment.</p> <p>B. Answering questions on eLearning for that particular lab.</p> <ul style="list-style-type: none"> You will be given 2-hour window to complete the prelab quiz. You will have two attempts to complete the pre-lab quiz. It will be due the night before the lab at 11:59 pm (i.e. Tuesday at midnight). <p>It is imperative that you have read and UNDERSTOOD the lab prior to beginning the pre-lab quiz. Students are expected to take the pre-lab quiz on their own, without help from anyone or the internet. However, students are permitted to use materials and/or textbook during the pre-lab quiz.</p> <p>Students who do not complete the pre-lab quiz will receive a score of zero for that pre-lab. There will be no extensions provided for the pre-lab.</p>
Post-Lab Assignments	<p>There are no formal lab reports for this course. You will have one week to complete the post-lab write-up. For example, the post-lab for the first lab that takes place 10:00–12:30 PM on Wednesday, Aug 30, 2023, the post-lab for that experiment will be due at 10:00 AM next Wednesday, Sept 6, 2023.</p> <p>Note: <u>Use scientific notations and rules of significant figures</u> when manipulating your data to improve accuracy. 0.000789 does not equal to 0.0008, it's 7.89×10^{-4}. Calculating this way might improve % error.</p>
Characterization Project	<p>You will select a material and characterize the sample using the methods learned in class.</p> <ol style="list-style-type: none"> Using the associated questions with the material, determine an experimental plan and sign up for characterization time.

	<ol style="list-style-type: none"> 2. After characterizing your sample, present your findings using powerpoint. Your presentation should include a brief introduction, relevant experimental details, your results, and your conclusions. 3. After completing a draft of your presentation and speaker notes, it will be reviewed by one of your classmates. 4. Based on their comments, you will update your presentation and speaker notes. You will present your slide deck the last week of class.
<p>Report on a Characterization Method</p>	<p>You will select a characterization method that is unfamiliar to you. (You will be provided a list of approved topics, but can select a method not listed with instructor approval.)</p> <ol style="list-style-type: none"> 1. Research the characterization method. The background knowledge from class will assist your understanding of the method. 2. Write an outline for your report that includes (a) the operating principles of the technique, (b) sample preparation and requirements, (c) how the technique is used for characterization, and (d) example of data and interpretation of results. 3. Using instructor feedback on your outline, write a full draft of the report. 4. You and your classmates will peer review the reports. 5. Based on their comments, you will update your report and submit your final report during finals week.

V. Course Policies

Class Attendance	Regular and punctual class attendance is expected. Students who fail to attend class regularly are inviting scholastic difficulty. Absences resulting from quarantining with COVID-19, however, will not be counted against the student.
Class Participation	Regular class participation is expected. Students who fail to participate in class regularly are inviting scholastic difficulty. A portion of the grade for this course is directly tied to your participation in this class. It also includes engaging in group or other activities during class that solicit your feedback on homework assignments, readings, or materials covered in the lectures.
Safety	<p>IMPORTANT: In accordance with University and Materials Science and Eng. Department safety rules, any time anyone (student, TA, instructor, or visitor) is in a lab, Z87-rated safety eyewear must be worn. In addition, arms, legs, and feet should be covered in lab. Short pants and skirts (which expose calves or thighs) are not allowed. Sleeveless shirts (including spaghetti strap shirts), or shirts that expose your midriff are also not allowed—however, a lab coat may be worn over these shirts during lab. Closed-toed shoes that fully cover your foot are also required. Hair longer than shoulder length must be put up in an appropriate manner to keep it out of harm’s way.</p> <p>In summary, all students are responsible for all information inside the undergraduate safety manual uploaded on eLearning.</p>
Classroom Materials	The instructor may provide class materials that will be made available to all students registered for this class as they are intended to supplement the classroom experience. These materials may be downloaded during the course, however, these materials are for registered students' use only.

	Classroom materials may not be reproduced or shared with those not in class or uploaded to other online environments except to implement an approved Office of Student AccessAbility accommodation. Failure to comply with these University requirements is a violation of the Student Code of Conduct.
Extra Credit	There will be no extra credit.
Late Work	Late assignments will be subjected to a 20% penalty per day, up to 3 days, after which they will not be accepted.
Classroom Citizenship	Cellular devices, gaming devices, and pagers must be turned off for lectures and exams.
Comet Creed	This creed was voted on by the UT Dallas student body in 2014. It is a standard that Comets choose to live by and encourage others to do the same: <i>“As a Comet, I pledge honesty, integrity, and service in all that I do.”</i>
Academic Support Resources	The information contained in the following link lists the University’s academic support resources for all students. Please go to http://go.utdallas.edu/academic-support-resources .
UT Dallas Syllabus Policies and Procedures	The information contained in the following link constitutes the University’s policies and procedures segment of the course syllabus. Please review the sections regarding the credit/no credit grading option and withdrawal from class. Please go to http://go.utdallas.edu/syllabus-policies for these policies.

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