

MTSE 5620 Scanning Electron and Ion Microscopy

SPRING 2026

Course Information

Instructor Information:

Instructor: Yufeng Zheng

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Website: [Advanced Metals, Manufacturing and Microscopy Group](#)

Office Hours: Thursday 11:00- 12:00PM (or by appointment, email preferred)

TA: Sydney Fields

Office: NTDP D115

Email: SydneyFields@my.unt.edu

Office Hours: Wednesday 10:00- 11:00AM (or by appointment, email preferred)

Course Description:

- Theory and applications of scanning electron microscopy and focused ion beam instrumentation. Topics covered include electron-solid and ion-solid interactions, electron and ion optics, image formation and analysis, X-ray microanalysis, electron backscattered diffraction analysis, focused ion beam patterning and deposition, and specimen preparation.
- This course is to provide the senior undergraduate students and graduate students with the advanced topics in scanning electron and ion microscopy, including secondary electron imaging, backscattered electron imaging, energy dispersive spectroscopy, electron backscattered diffraction and focused ion beam. The course will also provide the students with the hands-on experience of operation on scanning electron microscope (SEM) in the MTSE lab using the FEI Quanta 200 ESEM and HITACHI TM3030Plus Tabletop Microscope.

Course Pre/Co-requisites:

Prerequisites: Consent of instructor

Required texts, course materials:

Textbooks recommended:

- Scanning Electron Microscopy and X-Ray Microanalysis, J. Goldstein et. al., 4th Edition, Springer

Unique class procedures /structures:

- **Class Components:** 1) classroom lecture and 2) in-person lab in the Department of Materials Science and Engineering
- **Instruction Mode:** In person

Student Learning Objectives:

By the end of the course, you should be able to

- Apply scanning electron microscopy to explore the structure, composition and morphology of the materials at various length scales, especially metallic materials
- Work as a team to perform the lab session and complete the lab report individually on various topics in scanning electron microscopy
- Understand the imaging, EDS and EBSD pattern recorded using scanning electron microscope.
- Operate scanning electron microscope to analyze the structure, composition and morphology of the materials at various length scales.

Course Requirements:

For graduate students:

- Lab Reports: 35%
- Lab Practical Exam: 35%
- Final Exam: 30%
- Extra Credit: 5% (for 5 in-class surveys)

Grading Criteria, Scale, and Standards:

Grading Scale: A: 90-100; B: 80-89; C: 70-79; D: 60-69; F: <60

1. Six lab reports for SEM operation are required focusing on operation and alignment of the SEM; secondary electron imaging; backscatter electron imaging; energy dispersive spectroscopy; electron backscattered diffraction (EBSD); and FIB. No late report will be accepted unless instructor is contacted in advance with reasons.
2. One lab practical exam is required. It is student's responsibility to contact instructor to schedule the practical exam time.
3. One final exam is required, covering the topics of sample preparation, SEM alignment, important imaging modes, and widely used spectroscopy methods.

Late Work or Make-up Exams Policies

- No late report will be accepted unless instructor is contacted in advance with reasons.
- Make-up final can be arranged only if the instructor is contacted in advance with reasons.

Course Calendar or Topics Outline:

Tu/Th 4pm- 5:20pm, Lecture, Classroom: NTDP D212

Lab, Room: NTDP E-178, Day/Time: TBD

- Week 1: Syllabus
 - Lecture: Syllabus and intro
 - Lab: MRF and SEM Tour
- Week 2: SEM Fundamentals
 - Lecture: Introduction to SEM and Fundamentals of EM
 - Lab: Demonstration of SEM

- Week 3: SEM Instrument
 - Lecture: SEM instrument
 - Lab: Practical training on SEM user interface, sample loading, and SEM alignment
- Week 4: SEM Alignment
 - Lecture: SEM instrument
 - Lab: Practical training on SEM SE imaging
- Week 5: SEM Sample prep
 - Lecture: Sample prep
 - Lab: Practical training on SEM SE imaging
- Week 6: SEM Imaging
 - Lecture: SEM Imaging: Secondary Electron
 - Lab: Practical training on SEM BSE imaging
- Week 7: SEM Imaging
 - Lecture: SEM Imaging: Backscatter Electron
 - Lab: Practical training on SEM BSE imaging
- Week 8: SEM Imaging
 - Lecture: SEM Imaging: Backscatter Electron
 - Lab: Practical training on SEM EDS
- **Week 9: Spring Break**
 - Lecture: NO
 - Lab: NO
- Week 10: SEM: EDS (TMS Week)
 - Lecture: SEM EDS
 - Lab: Practical training on SEM EDS
- Week 11: SEM EBSD
 - Lecture: SEM EBSD
 - Lab: Practical training on SEM EBSD
- Week 12: MIPAR Image Analysis
 - Lecture: MIPAR image Analysis
 - Lab: Practical training on SEM EBSD
- Week 13: FIB
 - Lecture: FIB
 - Lab: Practical training on FIB
- Week 14: FIB
 - Lecture: FIB
 - Lab: Practical training on FIB
- Week 15: FIB
 - Lecture: Lab Practice
 - Exam: Lab Exam
- Week 16
 - Lecture: Review
- Final Exam: 05/05 (Tue) 3-5PM

Lab Report Calendar:

- Week 4
 - Lab Report 1
- Week 6
 - Lab Report 2
- Week 8
 - Lab Report 3
- Week 11
 - Lab Report 4
- Week 13
 - Lab Report 5
- Week 15
 - Lab Report 6
 - Practical Lab Exam
- Week 16
 - Final Exam

University Policies

Statement regarding Artificial Intelligence:

UNT acknowledges the evolving capabilities of Artificial Intelligence (AI) technologies and their various effects on student writing and content creation. Students are only permitted to use AI technology in the creation of any course content if permitted by the course instructor. If the use of AI technology is detected, without specific instructor permission, the student will be deemed in violation of the plagiarism policy.

The use of AI technologies is strictly prohibited for all coursework in this class, including homework, lab reports, and exams. Any use of AI tools for content generation, data analysis, or writing assistance without explicit instructor approval will be considered a violation of the plagiarism policy and subject to academic misconduct consequences as outlined by UNT. Students are expected to complete all assignments independently or collaboratively with their peers using their own understanding and effort.

Statement on Lab Safety

While working in laboratory sessions, students enrolled in SEM Lab are required to follow proper safety procedures and guidelines in all activities requiring lifting, climbing, walking on slippery surfaces, using equipment and tools, handling chemical solutions and hot and cold products. Students should be aware that UNT is not liable for injuries incurred while students are participating in class activities. All students are encouraged to secure adequate insurance coverage in the event of accidental injury. Students who do not have insurance coverage should consider obtaining Student Health Insurance. Brochures for student insurance are available in the UNT Student Health and Wellness Center. Students who are injured during class activities may seek medical attention at the Student Health and Wellness Center at rates that are reduced compared to other medical facilities. If students have an insurance plan other than Student Health Insurance at UNT, they should be sure that the plan covers treatment at this facility. If students choose not to go to the UNT Student Health and Wellness Center, they may be transported to an emergency room at a local hospital. Students are responsible for expenses incurred there.

Statement on Creating an Inclusive Learning Environment:

I value the many perspectives students bring to our campus. Please work with me to create a classroom culture of open communication, mutual respect, and belonging. All discussions should be respectful and civil. Although disagreements and debates are encouraged, personal attacks are unacceptable. Together, we can ensure a safe and welcoming classroom for all. If you ever feel like this is not the case, please stop by my office and let me know. We are all learning together.

Every student in this class should have the right to learn and engage within an environment of respect and courtesy from others. We will discuss our classroom's habits of engagement and I also encourage you to review UNT's student code of conduct so that we can all start with the same baseline civility understanding ([Code of Student Conduct](#)) (<https://policy.unt.edu/policy/07-012>).

Statement of Disability Services:

The University of North Texas makes reasonable academic accommodation for students with disabilities. Students seeking reasonable accommodation must first register with the Office of Disability Access (ODA) to verify their eligibility. If a disability is verified, the ODA will provide you with a reasonable accommodation letter to be delivered to faculty to begin a private discussion regarding your specific needs in a course. You may request reasonable accommodations at any time; however, ODA notices of reasonable accommodation should be provided as early as possible in the semester to avoid any delay in implementation. Note that students must obtain a new letter of reasonable accommodation for every semester and must meet with each faculty member prior to implementation in each class. Students are strongly encouraged to deliver letters of reasonable accommodation during faculty office hours or by appointment. Faculty members have the authority to ask students to discuss such letters during their designated office hours to protect the privacy of the student. For additional information, refer to the [Office of Disability Access](#) website (<https://studentaffairs.unt.edu/office-disability-access>). You may also contact ODA by phone at (940) 565-4323.

Statement for Academic Success Services:

UNT strives to offer you a high-quality education and a supportive environment, so you learn and grow. As a faculty member, I am committed to helping you be successful as a student. To learn more about campus resources and information on how you can be successful at UNT, go to unt.edu/success and explore unt.edu/wellness. To get all your enrollment and student financial-related questions answered, go to scrappysays.unt.edu.