

MSE2021: Materials Characterization

Credit Hours: 3-0-3-4

Course Description:

This course introduces the fundamental principles and techniques used for characterizing the microstructure and composition of materials. The focus will be on methods that utilize electromagnetic radiation and electrons, with both theoretical and practical applications being explored. Students will gain the skills necessary to analyze and interpret material properties at various scales.

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Office: GTE 103

Prerequisites: MSE 2001 – Principles & Applications of Engineering Materials

Course Websites:

<http://canvas.gatech.edu/>

Required Materials:

- No textbook is required; lecture notes and other resources will be provided.

Course Objectives and Outcomes:

1. X-ray Diffraction Techniques:

- Understand and explain the principles of X-ray diffraction in crystalline materials.
- Grasp the concept of the structure factor for single and binary systems.
- Perform reciprocal lattice parameter analysis.
- Apply X-ray techniques to measure particle size and strain.

2. Interaction of Light and Electrons with Materials:

- Describe how electron beams interact with materials to produce images.
- Understand the principles of X-ray microanalysis.
- Collaborate in teams to collect experimental data using X-ray diffraction, optical, and electron microscopy techniques.
- Analyze the data collected and compile detailed reports.

Learning Outcomes:

- Use principles from engineering, science, and mathematics to identify and solve complex engineering challenges.
- Design and conduct experiments, interpret data, and apply engineering judgment to draw meaningful conclusions.

Topics Covered:

1. Properties of Photons and Electrons
2. Atomic Structure
3. Optical Microscopy
4. Quantitative Stereology
5. Scanning Electron Microscopy (SEM)
6. Sample Preparation Techniques, Thin Film Deposition, and Resolution
7. X-ray Microanalysis
8. Microstructure and Crystallography
9. X-ray Diffraction

Grade Policy:

- 10% – Class Participation
- 10% – In-Class Quizzes
- 20% – Lab Reports
- 20% – Exam 1
- 20% – Exam 2
- 20% – Final Exam

Attendance Policy:

Attendance is mandatory for this course. Any unexcused absence will result in a grade of zero for both the in-class quiz during that session. In-class quizzes will be administered during the first 10 minutes of the period, and students arriving late will receive a zero for that quiz. Please note that no in-class quizzes will be given during scheduled lab hours to ensure sufficient time for the completion of lab work.

Make-Up Policy:

Students who miss an exam due to an Institute-sanctioned activity will be allowed to take a make-up exam. Make-up exams will only be granted for legitimate reasons, and it is essential that you contact me in writing (email is acceptable) prior to the scheduled exam to arrange a make-up. Failure to notify me in advance may result in the inability to schedule a make-up exam. When possible, make-up exams will be administered during the week following the original exam date. Please note that make-up exams may differ from the ones given during the regular exam period.

Academic Integrity:

All students enrolled in this course are expected to adhere to the Georgia Tech Honor Code and uphold the highest standards of academic integrity. Any violations or suspicions of academic misconduct will be reported to the Office of Academic Integrity and the Dean of Students for further investigation.

Collaboration:

While students are encouraged to discuss assignments in general terms, all work must be completed individually unless specified otherwise. You may seek help from the course instructors, but it is crucial that each student independently produces their own work. Copying any part of an assignment from another student, or allowing others to copy your work, is considered plagiarism and is strictly prohibited.