# MATSCEN 2331 Structure and Characterization Lab

## Course Description
Companion laboratory course to MSE-2241. Experiments on X-ray diffraction, scanning electron microscopy, optical microscopy, and stereology with applications. Statistical treatment of data and technical reporting.

**Transcript Abbreviation:** Struc Char Lab
**Grading Plan:** Letter Grade
**Course Deliveries:** Classroom
**Course Levels:** Undergrad
**Student Ranks:** Sophomore
**Course Offerings:** Spring
**Flex Scheduled Course:** Never
**Course Frequency:** Every Year
**Course Length:** 14 Week
**Credits:** 2.0
**Repeatable:** No
**Time Distribution:** 0.5 hr Lec, 2.5 hr Lab
**Expected out-of-class hours per week:** 3.0
**Graded Component:** Lecture
**Credit by Examination:** No
**Admission Condition:** No
**Off Campus:** Never
**Campus Locations:** Columbus
**Prerequisites and Co-requisites:** 2010, and Physics 1250 or 1260, and Math 1151 or 1161, and Chemistry 1210 or 1250, and enrollment as Matscen-BS student; or permission of instructor.
**Exclusions:** Not open to students with credit for MSE 282
**Cross-Listings:**

**Course Rationale:** Existing course.

**The course is required for this unit's degrees, majors, and/or minors:** Yes
**The course is a GEC:** No
**The course is an elective (for this or other units) or is a service course for other units:** No

**Subject/CIP Code:** 14.3101
**Subsidy Level:** Baccalaureate Course

## Programs

| Abbreviation | Description |
|---|---|
| MATSCEN | Materials Science and Engineering |

## Course Goals

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| Understanding basic operation and capabilities of the principal characterization methods used in materials science, namely XRD, optical microscopy and SEM. |
| Understanding the processing, evaluation and reporting of experimental data. |

## Course Topics

| Topic | Lec | Rec | Lab | Cli | IS | Sem | FE | Wor |
|---|---|---|---|---|---|---|---|---|
| X-ray Diffraction Lab: Diffractometer operation and sample preparation. Analytical treatment of data for simple unknown structures. Computer-based pattern matching for more complex unknown structures, including texture and particle size effects. | | | 9.0 | | | | | |
| Optical Microscopy Lab: Sample preparation. Grain size and volume fraction measurement. Use of image analysis/stereological software. | | | 6.0 | | | | | |
| Scanning Electron Microscopy Lab: Interpreting various imaging modes. Analysis of Al-Si microstructures and relationship to phase diagram. Energy dispersive spectroscopy (EDS) analysis of phase compositions. | | | 8.0 | | | | | |
| Orientation Imaging Microscopy Lab: Automated measurement of grain size and twin fraction. Determination of global and local textures. | | | 6.0 | | | | | |
| 3D Microscopy Lab: Stereomicroscopy on fracture surfaces/porous structures. Quantitative surface topography using 3D digital optical microscope. Comparison of 3D serial section datasets (to be provided to students) and 2D stereology. | | | 8.0 | | | | | |
| Statistical treatment of data including sources and types of error,<br>weighted averaging, scatter, and regression. | | | 5.0 | | | | | |

## Representative Assignments

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| Phase identification and precise lattice parameter determination by XRD. |
| Measurement of grain size in opaque material (e.g. Aluminum oxide ceramic). |
| Compare XRD and OIM techniques for measuring texture in processed sheets and supported thin films. |

## Grades

| Aspect | Percent |
|---|---|
| Two full lab reports on XRD and SEM techniques | 70% |
| Three brief reports on optical microscopy, orientation imaging and fractography/3D microscopy. | 30% |

## Representative Textbooks and Other Course Materials

| Title | Author |
|---|---|
| *Electron Microscopy and Analysis, 3rd ed., 2000.* | P. J. Goodhew, F. J. Humphreys and R. Beanland |
| *Introduction to Materials Science and Engineering, 2010* | W. D. Callister |
| *Elements of X-Ray Diffraction* | B. D. Cullity |

## ABET-EAC Criterion 3 Outcomes

| Course Contribution | | College Outcome |
|---|---|---|
| *** | a | An ability to apply knowledge of mathematics, science, and engineering. |
| *** | b | An ability to design and conduct experiments, as well as to analyze and interpret data. |
| | c | An ability to design a system, component, or process to meet desired needs. |
| | d | An ability to function on multi-disciplinary teams. |

| Course Contribution | | College Outcome |
|---|---|---|
| | e | An ability to identify, formulate, and solve engineering problems. |
| | f | An understanding of professional and ethical responsibility. |
| ** | g | An ability to communicate effectively. |
| | h | The broad education necessary to understand the impact of engineering solutions in a global and societal context. |
| | i | A recognition of the need for, and an ability to engage in life-long learning. |
| | j | A knowledge of contemporary issues. |
| *** | k | An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. |

**Prepared by:** Michael Mills