

# MATSCEN 2331 (Approved): 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:** Prerequisite: MSE 2010, Co-requisite: MSE 2241; or permission of instructor

**Exclusions:**

**Cross-Listings:**

**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

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, weighted averaging, scatter, and regression.			5.0					

## Representative Assignments

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
<i>Electron Microscopy and Analysis, 3rd ed., 2000.</i>	P. J. Goodhew, F. J. Humphreys and R. Beanland
<i>Introduction to Materials Science and Engineering, 2010</i>	W. D. Callister
<i>Elements of X-Ray Diffraction</i>	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.

<b>Course Contribution</b>		<b>College Outcome</b>
	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**