

MSE 2021: Characterization of Materials (required)

Catalog Description: (3-3-4)

Prerequisite: MSE 2001

To teach the principals of external and internal characterization of materials by presenting the theory and operating principals of x-ray diffraction and scattering, scanning and electron microscopy (SEM), x-ray chemical microanalysis, and stereological characterization. The student should complete the course with sufficient experience to utilize x-ray diffraction, optical microscope and SEM on a practical basis.

Textbook:

1- Class Notes

2- Elements of X-ray Diffraction, Cullity and Stock

Reference:

1-ASM Handbook, Volume 9, pages 257-268, 325-367, 428-447, 0-87170-706-3

2- Microstructural Characterization of Materials, David Brandon and Wayne D. Kaplan, Wiley

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Topics Covered:

1. Properties of Photons and Electrons
2. Atomic Structure
3. Optical Microscopy
4. Quantitative Stereology
5. Scanning Electron Microscopy -
6. Sample preparation techniques, thin film deposition, and resolution
7. X-ray microanalysis
8. Microstructure and Crystallography
9. X-ray Diffraction

Course Outcomes/ Relationship to Student Outcomes/Expected Performance Criterion:

Outcome 1: The student will develop an understanding on the principles and operation of X-ray Diffraction

- 1.1 Describe x-ray diffraction in crystalline materials.
- 1.2. Describe structure factor for single and binary systems.
- 1.3. Describe reciprocal Lattice parameter analysis.
- 1.4. Describe particle size and strain measurement using x-ray techniques.

Outcome 2: Understand the basics and operation of light and electron interaction with materials to get an image in different scales

2.1. Describe electron beam /materials interaction to form an image.

2.2. Describe x-ray microanalysis.

2.3. Acquire experimental data in a team of 4-5 from x-ray diffraction, optical and electron microscopy and prepare reports.

2.4. Perform statistical analysis of the experimental data acquired.

The Course Outcomes are listed in the Outcomes Table below. At least 80% of the students are expected to score 80% or greater on exam questions/assignments used to assess each Course Outcome.

Correlation between Course Outcomes and Student Outcomes:

Course Outcomes	Student Outcomes										
	a	b	c	d	e	f	g	h	i	j	k
Course Outcome 1.1	x	x								x	
Course Outcome 1.2	x	x								x	
Course Outcome 1.3	x	x								x	
Course Outcome 1.4	x	x								x	
Course Outcome 2.1	x	x								x	
Course Outcome 2.2	x	x								x	
Course Outcome 2.3	x	x		x	x	x	x		x		x
Course Outcome 2.4	x	x									x
Entire Course	2	3	0	1	1	0	1	0	0	2	3
0 = None or insignificant; 1 = Some; 2 = Moderate; 3 = Strong											

School of Materials Science and Engineering Student Outcomes:

- (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 2
- (c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- (d) an ability to function on multidisciplinary teams 5
- (e) an ability to identify, formulate, and solve engineering problems 6
- (f) an understanding of professional and ethical responsibility 7
- (g) an ability to communicate effectively 8
- (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context 9
- (i) a recognition of the need for, and an ability to engage in life-long learning 10
- (j) a knowledge of contemporary issues 11

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice