**MSE 488 – Scanning Electron Microscopy**
____ required __X_ elective

**Catalog Description:** MSE 488 - **Scanning Electron Microscopy** (3 units)
Theoretical and practical aspects of electron-beam microanalysis. Lab emphasizes projects and independent research using scanning electron microscopy (SEM) and energy dispersive X-ray (EDX) analysis.

**Prerequisite(s):** Consult department before enrolling.

**Textbook:** Goldstein et al., 2003, *Scanning Electron Microscopy and X-Ray Microanalysis*, Kluwer; 3rd edition

**References:** Chandler and Seraphin, 1999, Scanning Electron Microscopy, *Methods in Materials Research*, 1999, 11a.1.1-11a.1.14.

**Overall Objective:** This course is designed to provide students with the necessary background and skills for independent SEM/EDX microanalysis on a wide variety of materials

**Specific Instructional Goals:** Students successfully completing the course will be capable of preparing their own samples, analyzing, and interpreting the results of their analysis. Also expected is the ability to choose correct analytical techniques, procedures, and hardware; and incorporate data into an appropriate presentation of results.

**Topics Covered:**

**Lecture (Class Hours)**
1. Introduction and comparison to other techniques (2)
2. Electron optics and SEM hardware (3)
3. Specimen preparation (2)
4. Electron beam interactions with solids (4)
5. Image formation, detectors, and contrast (3)
6. Imaging modes, resolution (2)
7. Energy dispersive spectrometry and qualitative analysis (2)
8. Quantitative EDS analysis (2)
9. Compositional imaging (1)
10. High-resolution SEM, low voltage SEM (2)
11. Variable pressure SEM (1)
12. Special topics and related techniques (specific to individual research projects; Auger, WDS, FIB, TEM, special preparation techniques, EBIC, etc.) (3)

**Laboratory (Weeks)**
1. Basic operation procedures and sample preparation (3)
2. SEM imaging modes, contrast, resolution (5)
3. EDS qualitative and quantitative analysis, compositional imaging (4)
4. Individual research project (4)

**Class Schedule:**

1. Two lecture sessions per week.
2. One three-hour laboratory session per week.
3. Laboratory assignments for group and individual time on the instrument.
4. Two laboratory reports.
5. Two quizzes.
6. One midterm and one final examination.
7. One term paper on individual research project.

**Computer Usage:**

1. Student must utilize computer software for digital imaging, EDS analysis.
2. Student is introduced to image analysis and presentation software, and must prepare laboratory reports and individual research report for presentation in various formats.
3. One laboratory session on Monte-Carlo simulations of electron beam interaction with solids.

**Contribution to Professional Component:**

| | | |
|---|---|---|
| ____% Math & Basic Sci. | ____credits Math & Basic Sci. | |
| 80 % Engr. Science | 3 credits Engr. Topics | |
| 20 % Engr. Design | | |

**Relationship to Program Outcomes:**

| Level of Activity (High, Medium, or Low) | PROGRAM OUTCOMES - To produce graduates who can: |
|---|---|
| M | apply the fundamentals of mathematics, the physical and/or life sciences, and engineering principles. |
| M | apply the fundamentals of materials science and engineering, the interrelationship among processing, microstructure, properties, and performance, and can apply that knowledge in solving problems. |
| M | work individually and in teams in order to define alternative solutions from diverse knowledge bases and implement an acceptable solution in a local, national or global context. |
| H | communicate effectively in verbal presentations, written reports and other media. |
| H | utilize modern engineering tools used in the profession. |
| L | use resources such as library facilities, the internet, data bases, professional society offerings, etc., as part of life-long learning. |
| | value life-long learning and can put into action their responsibilities to the profession and society. |

**Person preparing syllabus** **Supapan Seraphin**