



PHYS 296B, Spring 2020

Microstructure & Surface Analysis

Lecture: T, 13:15-14:30.
Waterman Building 423



Instructor

Matthew White

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Course Description: This class will explore the theory and practical operation of several advanced techniques to analyze the structure, composition, and surfaces of micro and nano-scale materials. Students will be fully trained as users of a Field Emission Scanning Electron Microscope (FESEM) including x-ray elemental analysis and electron diffraction crystal structure analysis. There will be four practical assignments, a presentation, and a final written exam.

Prerequisite(s): PHYS 128 or equivalent.

Credits: 1

Online Communication Resources: All students must have reliable access to the University of Vermont Blackboard course website. This access requires internet connection, which is free of charge for all UVM students while on campus. You will need your UVM net ID and password to log into the Blackboard system. All supplementary course materials, course updates and announcements will be made via the Blackboard system. **It is the student responsibility to check his/her UVM email and Blackboard course website for updates at least once a day!**

Assignments: The four assignments will be completed in pairs (or small groups depending on enrollment) as follows:

1. A theoretical assignment on the basic physics behind the operation of an FESEM and detectors.
2. An imaging assignment, requiring imaging of multiple surfaces features at various scales.
3. An elemental composition assignment, requiring the qualitative and quantitative analysis of a sample composition
4. A crystal grain structure analysis assignment, requiring the determination of a mineral based on the crystal structure, identification of grain boundaries, and the determination of grain size

*Graduate student participants will be required to complete additional practical work for assignments 2 and 3, providing surface imaging and elemental composition analysis of research-relevant samples. That is, samples that are either related to the student research project or are otherwise

non-standard and not prepared for optimal imaging. Graduate student participants will also provide a written summary of the results of assignments 2, 3, and 4 in the style of a published journal article, with introduction, results and discussion, and experimental details, and will be evaluated both on the quality of the imaging, the analysis, and the science-writing, with half of the grade based on the assigned imaging of standard samples and half based on the advanced imaging and written report.

Presentation: Working in groups (size to be determined), students will prepare and present a final presentation covering one theoretical aspect of the FESEM operation, and showing the results of the imaging and analysis assignments.

*Graduate students will provide a written report in the style of a journal article to accompany their presentation, focusing on the FESEM operation aspect as the assignments will already have an accompanying written report, with half of the grade based on the presentation and half based on the written report.

Final Exam: A final exam will test student understanding of the operational principles that govern the FESEM and the various detectors.

Course Grades: Each student will receive a grade based on the grades of the Assignments, Presentation, and Final Exam. The individual components will be scaled and converted to letter grades according to:

Assignments	60% (15% each)
Presentation	20%
Final Exam	20%

A	=	90 - 100%
B	=	80 - 89.9%
C	=	70 - 79.9%
D	=	60 - 69.9% (only for undergraduate students)
F	=	59.9% or below *(69.9% and below for graduate students)

Within each letter grade, the + and - will indicate above and below the corresponding 7% and 3%. For example, grades above 77% but below 80% will receive a C+. All grades will be posted on Blackboard to ensure privacy. It is each student's responsibility to verify the accuracy of the postings regularly. **Report any discrepancies promptly.**

Academic Dishonesty Disclosure: Academic dishonesty **will not be tolerated.** Perceived failures to abide by the standards of academic integrity will be prosecuted as set forth in the University of Vermont Code of Academic Integrity. The code states the four standards of academic integrity; that students may not plagiarize, fabricate, collude, or cheat.

Disability Services: In keeping with University policy, any student with a documented disability interested in utilizing accommodations should contact ACCESS, the office of Disability Services on campus. ACCESS works with students and faculty in an interactive process to explore reasonable and appropriate accommodations, which are communicated to faculty in an accommodation letter. All students are strongly encouraged to meet with their faculty to discuss the accommodations they plan to use in each course. A student's accommodation letter lists those accommodations that will not be implemented until the student meets with their faculty to create a plan. Contact ACCESS: A170 Living/Learning Center; 802-656-7753; access@uvm.edu; or www.uvm.edu/access.