MSE710 Electron Microscopy
SPRING 2020

Course Information

Instructor Information:

Instructor: Yufeng Zheng
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Email: yufengz@unr.edu
Office Hours: Thursday 4:30PM- 5:30PM (or by appointment)
Course website: https://packpages.unr.edu/yufengz/teaching/

Course Description:

This course is to provide the graduate students in the College of Engineering with the fundamentals of various advanced materials characterization techniques including scanning electron microscopy (SEM), focused ion beam (FIB) and transmission electron microscopy (TEM), as well as the hands-on experience of these techniques at the Electron Microscopy & Microanalysis Facility (EMMF) in the Department of Chemical and Materials Engineering. Basics of diffraction, image formation, and elemental analysis in the SEM, FIB and TEM will be discussed in the lecture. The operation procedures for the FEI Nova NanoSEM 600, Thermo Scientific Scios 2 DualBeam and JEOL JEM 2100F Analytical TEM available at EMMF will be introduced. The frontier of the applications of SEM, FIB and TEM in the area of Materials Science and Engineering will be covered. Through this course, students will obtain the training for the advanced characterization facilities at the EMMF.

Course Pre/Co-requisites:

Prerequisites: MSE 415/615 Materials Characterization, MSE416/616 X-Ray Diffraction

Required texts, course materials:

Textbooks recommended:


Unique class procedures /structures:

This class will contain 1) classroom lecture and 2) lab or lab demo at Electron Microscopy & Microanalysis Facility in the Department of Chemical and Materials Engineering.
Student Learning Outcomes:
Upon completion of this course, students will be able to:
(a) apply engineering research and theory to advance the art, science, and practice of the discipline
(b) design and conduct experiments as well as to analyze, interpret, apply, and disseminate the data

Course Requirements:
Class attendance and participation: 10%
Lab report: 20%
Midterm exam: 25%
Final exam: 45%
Quiz and Survey: 10% (extra credit)

Grading Criteria, Scale, and Standards:
A: 93% - 100%
A-: 90% - 92.9%
B+: 87% - 89.9%
B: 84% - 86.9%
B-: 80% - 83.9%
C+: 77% - 79.9%
C: 74% - 76.9%
C-: 70% - 73.9%
D+: 67% - 69.9%
D: 64% - 66.9%
D-: 60% - 63.9%
F: <60%

1. Class attendance is required. If students have to miss a class for a legitimate reason, instructor needs to be informed IN WRITTEN.
2. One lab report for SEM is required. No late report will be accepted unless instructor is contacted in advance with reasons.
3. One midterm exam and one final exam are required. Midterm exam will focus on the SEM and final exam will only cover the content related to TEM. Make up exam can be scheduled if the instructor to be informed IN WRITTEN in advance with reasons.

Course Calendar or Topics Outline:
Tuesday & Thursday 3pm- 4:15pm, Lecture, Classroom: FA 337
Lab or Lab Demo, LME 106A
- Week 1
  - 01/21, Lecture: Introduction to Scanning Electron Microscopy (SEM)
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- 01/23, Lecture: Fundamentals of Diffraction Theory
- **Week 2**
  - 01/28, Lecture: SEM Instrumentation
  - 01/30, **Lab: SEM basic alignment**
- **Week 3**
  - 02/04, Lecture: SEM Imaging
  - 02/06, **Lab: SEM basic alignment, SE and BSE imaging**
- **Week 4**
  - 02/11, Lecture: SEM X-ray Energy-Dispersive Spectrometry (EDS)
  - 02/13, **Lab: SEM basic alignment, SEM EDS**
- **Week 5**
  - 02/18, Lecture: SEM Electron Backscatter Diffraction (EBSD)
  - 02/20, **Lab: SEM basic alignment, SEM EBSD**
- **Week 6**
  - Lab Report Prep Week, 02/25 & 02/27, **SEM Lab, Imaging, EDS and EBSD**
- **Week 7**
  - 03/03, Lecture: Review class for Midterm exam (**SEM Lab Report due**)
  - 03/05, Lecture: Frontier of SEM
- **Week 8**
  - 03/10, **Midterm exam**
  - 03/12, Lecture: FIB and sample prep
- **Week 9**
  - Spring break, No classes
- **Week 10**
  - 03/24, **Lab: FIB Demo**
  - 03/26, Lecture: Introduction to Transmission Electron Microscopy (TEM)
- **Week 11**
  - 03/31, Lecture: Instrument and Sample Preparation
  - 04/02, Lecture: Diffraction from Crystals
- **Week 12**
  - 04/07, Lecture: Index TEM Diffraction
  - 04/09, Lecture: TEM Imaging
- **Week 13**
  - 04/14, Lecture: TEM Imaging
  - 04/16, **Lab: TEM Demo**
- **Week 14**
  - 04/21, Lecture: TEM X-ray Energy-Dispersive Spectrometry
  - 04/23, **Lab: TEM Demo**
- **Week 15**
  - 04/28, Lecture: Electron Energy-Loss Spectrometry
  - 04/30, Lecture: Review class for final exam
- **Week 16**
  - 05/05, Frontier of Transmission Electron Microscopy
University Policies

Statement on Academic Dishonesty:

Cheating, plagiarism or otherwise obtaining grades under false pretenses constitute academic dishonesty according to the code of this university. Academic dishonesty will not be tolerated and penalties can include filing a final grade of "F"; reducing the student's final course grade one or two full grade points; awarding a failing mark on the coursework in question; or requiring the student to retake or resubmit the coursework. For more details, see the University of Nevada, Reno General Catalog.

Academic dishonesty is against university as well as the system community standards. Academic dishonesty is defined as: cheating, plagiarism or otherwise obtaining grades under false pretenses. Plagiarism is defined as submitting the language, ideas, thoughts or work of another as one's own; or assisting in the act of plagiarism by allowing one's work to be used in this fashion. Cheating is defined as: (1) obtaining or providing unauthorized information during an examination through verbal, visual or unauthorized use of books, notes, text and other materials; (2) obtaining or providing information concerning all or part of an examination prior to that examination; (3) taking an examination for another student, or arranging for another person to take an exam in one's place; (4) altering or changing test answers after submission for grading, grades after grades have been awarded, or other academic records once these are official.

Disciplinary procedures for incidents of academic dishonesty may involve both academic action and administrative action for behavior against the campus regulations for student conduct. The procedures involve the determination by the faculty members pursuing concerns over alleged cheating or plagiarism as to whether administrative action is warranted, in addition to making a determination as to any academic consequence. Academic action may include: (1) canceling the student’s enrollment in the class without a grade; (2) filing a final grade of “F”; (3) awarding a failing mark on the test or paper in question; (4) requiring the student to retake the test or resubmit the paper.

Statement of Disability Services:

“Any student with a disability needing academic adjustments or accommodations is requested to speak with me or the Disability Resource Center (Pennington Achievement Center Suite 230) as soon as possible to arrange for appropriate accommodations.”

This course may leverage 3rd party web/multimedia content, if you experience any issues accessing this content, please notify your instructor.

Statement for Academic Success Services:

University of Nevada, Reno provides the following services to help you achieve academic success and the usage is covered by your student fees: Math Center [(775) 784-4433], University Tutoring Center [(775) 784-6801], and University Writing Center [(775) 784-6030]. These centers support your classroom learning; it is your responsibility to take advantage of their services.

The University Math Center (UMC) is focused on helping students with mathematical and statistical concepts. While mathematics is used extensively in engineering, the UMC does not have the resources to help students with engineering courses. Engineering students are encouraged to use the UMC for
help in their math classes, and they are welcome to use its computer lab and study area any time – regardless of courses. However, UMC tutors cannot answer questions regarding engineering courses.

Statement on Audio and Video Recording:

"Surreptitious or covert video-taping of class or unauthorized audio recording of class is prohibited by law and by Board of Regents policy. This class may be videotaped or audio recorded only with the written permission of the instructor. In order to accommodate students with disabilities, some students may have been given permission to record class lectures and discussions. Therefore, students should understand that their comments during class may be recorded."

The University of Nevada, Reno is committed to providing a safe learning and work environment for all. If you believe you have experienced discrimination, sexual harassment, sexual assault, domestic/dating violence, or stalking, whether on or off campus, or need information related to immigration concerns, please contact the University's Equal Opportunity & Title IX office at 775-784-1547. Resources and interim measures are available to assist you. For more information, please visit the Equal Opportunity and Title IX page.