

EMA3513C Analysis of the Structure of Materials

Prof. Kevin S. Jones

160 Rhines Hall

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1. Catalog Description:

Fundamentals of crystallography, x-ray and electron diffraction, scanning and transmission electron microscopy, surface analysis and microprobe techniques. Laboratory. (Credits: 4)

2. Prerequisites:

EMA3010

3. Course Objectives:

EMA 3513 is the Materials Science and Engineering department's introduction to the characterization of materials. As such, the objectives of this course are:

- a. to familiarize the student with the basic understanding of photon/matter interactions, specifically x-ray generation and interaction with solids
- b. to introduce the students to methods of analytical analysis of materials
- c. to introduce the student to basic crystallography including stereographic projections and to then introduce various methods of characterizing the structure of solids
- d. to allow the students the opportunity to design and perform the open ended analysis of the composition and structure of the components in a complex engineering system (e.g. a computer) and subsequently present their findings orally in class

The goal of this class is to provide the students with the basic understanding and practical knowledge necessary to characterize an unknown material both chemically and microstructurally.

This 4 credit course will address the professional component of ABET by providing 1 credit of basic science in understanding atomic and molecular physics, 2 credits in Engineering science of materials characterization and 1 credit of engineering design in the development of an approach to the characterization of an unknown engineered object

This year in the lab we will be characterizing the composition and structure of the components of a variety of devices.

This course addresses the following MSE Program outcomes:

- a) Ability to apply knowledge of mathematics, science and engineering to materials systems (medium coverage) This will be assessed through questions on quizzes and tests
- b) Ability to conduct experiments analyze and interpret data (medium coverage). This will be assessed through the oral presentations of lab results.
- c) Ability to function on multi-disciplinary teams (low coverage). This will be peer assessed by your teammates.
- d) Ability to communicate effectively in both oral and written form (medium coverage). This will be assessed through the oral presentations of lab results and the written lab report.
- e) Ability to use techniques skills and tools needed for practice as a materials engineer (medium coverage) This will be assessed through evaluation lab quizzes.
- f) Ability to engage in lifelong learning. This will be assessed by grading the ability of students to do the on-line research needed for the characterization reports and presentations.

4. Instructor: Dr. Kevin Jones

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Period 4, MW or by appointment

5. Laboratory Teaching Assistant:

Ajantiwalay, Tanvi [t.ajantiwalay@ufl.edu](mailto:t.ajantiwalay@ufl.edu)

Ribhu Sharma

Third TA tba

6. Class Meeting Times:

M W F 3<sup>rd</sup> Period (9:35-10-25AM) TUR L005

7. Laboratory Schedule:

Lab starts the Week of January 14th

8. Material and Supply Fees:

\$35/student

9. Textbooks and Software Recommended:

Materials Characterization

Yang Leng

Any edition

ISBN: 9780470822982

Recommended Reading:

Elements of X-Ray Diffraction

B.D. Cullity  
Any edition  
ISBN: 0-201-61091-4

#### 10. Course Outline:

Week 1 – Chapter 1 section 1.1/handout on x-rays  
Week 2 – X-Ray Formation and absorption  
Week 3 – Chapter 5 SEM and FIB  
Week 4 – Chapter 6 EDS/EELS  
Week 5 – Chapter 8 XPS/AES  
Week 6 – Chapter 8 AES/SIMS  
Week 7 – Handout FTIR  
Week 8 – Chapter 1 section 1.2 Crystallography  
Week 9 – Stereographic Projections  
Week 10 – Spring Break  
Week 11 – Chapter 2 X-Ray Diffraction  
Week 12 – Structure Factor  
Week 13 – Diffraction Methods  
Week 14 – Transmission Electron Microscopy  
Week 15 – Reverse Engineering Symposium  
Week 16 – Classes End

#### 11. Attendance and Expectations:

There are no penalties for class absences, however I do ask you show up punctually and class participation is considered subjectively as part of your final grade. Lab attendance is part of your grade.

#### 12. Grading:

Quizzes 30%, Exam 1 20%, Exam 2 20%, Lab attendance 5%, Presentations 20%, Class Participation 5% (based on peer assessment)

#### 13. Grading Scale:

92-100= A; 91-89 = A-; 88-86 = B+; 85-82 = B; 81-79= B-; 78-76 = C+; 75-72 = C; 71-69 = C-; 68-66 = D+; 65-62 = D; 61-59 = D-; Less than 59 = E. Grades may be curved up at the end of the course at the discretion of the instructor.

#### 14. Make-up Exam Policy

All missed exams and quizzes must be scheduled ahead of the absence with either the instructor or TA. Emergency and Medical absences will require verification.

15. Honesty Policy – All students admitted to the University of Florida have signed a statement of academic honesty committing themselves to be honest in all academic work and understanding that failure to comply with this commitment will result in disciplinary action. This statement is a reminder to uphold your obligation as a UF student and to be honest in all work submitted and exams taken in this course and all others.
16. Accommodation for Students with Disabilities – Students Requesting classroom accommodation must first register with the Dean of Students Office. That office will provide the student with documentation that he/she must provide to the course instructor when requesting accommodation.
17. ***UF Counseling Services*** – Resources are available on-campus for students having personal problems or lacking clear career and academic goals. The resources include:
  - University Counseling Center, 301 Peabody Hall, 392-1575, personal and career counseling.
  - SHCC Mental Health, Student Health Care Center, 392-1171, personal counseling.
  - Center for Sexual Assault/Abuse Recovery and Education (CARE), Student Health Care Center, 392-1161, sexual assault counseling.
  - Career Resource Center, Reitz Union, 392-1601, career development assistance and counseling.
18. Software Use – All faculty, staff and student of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.