



University of Central Florida
Mechanical, Materials & Aerospace Engineering Department

EMA 3012C
Experimental Technique in Mechanics and Materials
Fall Semester 2007

INSTRUCTOR:

Dr. Nina Orlovskaya
Office: Engineering I, Room 112
Phone: 407-823-5770
Email: norlovsk@mail.ucf.edu
Office Hours: Monday, 11-12 A.M. in 112, ENG I

TEACHING ASSISTANT:

TBA

COURSE CREDIT AND ORGANIZATION:

3 credit hours. The course comprises of hands on laboratory training and classroom lectures. The class (all sections) meets on Tuesday, Thursday; 12:00 P.M. -12:50 P.M. in Eng II, Room 105. The laboratory schedule for all sections is presented below.

Section 0011	Tuesday	1:30 – 3:20 PM	ENG I 157
Section 0012	Tuesday	6:00 – 7:50 PM	ENG I 157
Section 0013	Thursday	1:30 – 3:20 PM	ENG I 157
Section 0014	Thursday	6:00 – 7:50 PM	ENG I 157

PREREQUISITES (PR):

EGN 3365 Structure and Properties of Materials
EML 3601 Solid Mechanics

TEXTBOOK:

Experimental Techniques in Mechanics and Materials, C. Suryanarayana, John Wiley & Sons Inc., 1st Edition, 2006.

COURSE OBJECTIVES:

- 1.) To realize the importance of various experimental techniques in understanding the behavior of engineering materials.
- 2.) To learn, appreciate and correlate the importance of microstructure with various mechanical properties of materials
- 3.) To gain hands on knowledge on various experimental techniques used in understanding materials.
- 4.) To appreciate the structure-property relationship in materials science and engineering.
- 5.) To be able to use the knowledge gained for materials design and selection in engineering

COURSE DESCRIPTION:

The course will provide hands-on experience with various experimental techniques that are used in characterizing materials, which include crystal structures, microstructures, vibrational properties of the lattices, and mechanical properties such as hardness, strength and toughness. The course will consist of two hours (50 min each) of lecture and two hours of laboratory every week. The lectures will cover topics including atomic structure, X-ray diffraction, heat treatment of steels, failures in metals, tensile testing, hardness testing, impact testing, compression testing, creep and fatigue failures and corrosion behavior. Emphasis in the laboratory will be on hands-on experience. The calculations of the theoretical densities of the selected materials will be performed.

At the completion of the course, the students are expected to be fully familiar with a broad spectrum of techniques available for materials characterization. The students will also be able to decide on the best technique(s) to characterize the given material for a specific application.

GRADING:

Homework and Quizzes	15%
Laboratory reports	35%
Midterm Exam	15%
Final Exam	35% (Comprehensive)

The final grade assigned will include +/- modifiers.

ASSIGNMENTS:

Reading: You should read the assigned topics before the class in which they will be discussed. This will make the lecture more understandable and will enable you to be prepared to ask questions.

Written: Homework problems will be assigned regularly. Quizzes and exams will contain questions related to homework problems.

GENERAL POLICIES:

- 1.) There will be no make-up exam and quizzes given. In case of emergency/illness, special arrangements will be made on one-to-one basis.
- 2.) Feedback and suggestions are always welcome.

- 3.) Class participation is strongly encouraged and attendance is important.
- 4.) To enhance learning and for your convenience, some class notes will be made available to you through <http://webct.ucf.edu>. You will have to log on to the web using your PID and password. If you have any questions or if you are not familiar with WebCT, please contact WebCT specialist Ms. Kim Okamoto in Room 289 ENG I; Telephone 407-823-5248.

APPROACH:

- I. Practice Oriented Learning
- II. Visualization/Application
- III. Qualitative

REFERENCES:

- 1.) Foundations of Materials Science and Engineering by W.F. Smith, McGraw Hill, Third edition, 2004.
- 2.) Introduction to Materials Science for Engineers: Shackelford, James F., Prentice Hall.
- 3.) The Principles of Engineering Materials, Barrett, Nix and Tetalman, Prentice Hall, Englewood Cliffs, NJ.
- 4.) Mechanical Metallurgy, George E. Dieter, McGraw Hill
- 5.) Introduction to Physical Metallurgy, Sidney H. Avner, McGraw Hill
- 6.) Materials Science and Engineering – An Introduction, William D. Callister Jr., John Wiley & Sons Inc., 6th edition, 2002.

LECTURE SCHEDULE

<u>Week</u>	<u>Date</u>	<u>Topic</u>
1	Aug 21 (T)	Syllabus and Introduction to EMA 3012C
	Aug 23 (R)	Classification of Materials
2	Aug 28 (T)	Bonding
	Aug 30 (R)	Crystal Symmetry/Geometry
3	Sep 04 (T)	Theoretical Density
	Sep 06 (R)	Structure and Density Calculation
4	Sep 11 (T)	Review of Waves; Production of X-Ray; X-Ray Spectra
	Sep 13 (R)	X-Ray/Electron Diffraction; Bragg's Law
5	Sep 18 (T)	Optical Microscopy
	Sep 20 (R)	Electron Microscopy
6	Sep 25 (T)	Elastic/Inelastic scattering
	Sep 27 (R)	Properties of the Solids by micro-Raman spectroscopy
7	Oct 02 (T)	Basics of Metallography
	Oct 04 (R)	Qualitative Metallography
8	<u>Oct 09 (T)</u>	<u>Class Examination Midterm</u>
	Oct 11 (R)	Phase Diagrams
9	Oct 16 (T)	Iron-Carbon Phase Diagram
	Oct 18 (R)	Phase Transformation in Metals
10	Oct 23 (T)	Mechanical Properties: Hardness Testing
	Oct 25 (R)	Heat Treatment of Steel
11	Oct 30 (T)	Hardenability of Steels
	Nov 01 (R)	Nomenclature of Ferrous Alloys
12	Nov 06 (T)	Deformation Behavior: Strength/Young's Modulus
	Nov 08 (W)	Tensile Testing
13	Nov 13 (T)	Failures: Ductile and Brittle
	Nov 15 (R)	Impact Testing and Toughness
14	Nov 20 (T)	Thanksgiving
	Nov 22 (R)	Thanksgiving
15	Nov 27 (T)	Fatigue Failures and Testing
	Nov 29 (R)	Creep and High Temperature Failures
16	Dec 04 (T)	Final Examination

LABORATORY SCHEDULE

Lab 1 (Week 2)	Impact Testing
Lab 2 (Week 3)	Theoretical Density Calculation/Density Measurements
Lab 3 (Week 4)	Structure Determination by X-ray Powder Diffraction
Lab 4 (Week 5)	Tour of Materials Characterization Facility and Scanning Electron Microscopy (Demo)
Lab 5 (Week 6)	Micro-Raman Spectroscopy
Lab 6 (Week 7)	Optical Metallography: Basics of Specimen Preparation
Lab 7 (Week 8)	Optical Metallography: Observation and Analyses
Lab 8 (Week 9)	Rockwell and Vickers Hardness Testing
Lab 9 (Week 10)	Tensile Testing
Lab 10 (Week 11)	Effect of Heat Treatment on Hardness/Microstructure of Steels
Lab 11 (Week 12)	Estimation of Hardenability by Jominy End Quench Test
Lab 12 (Week 13)	Calorimetry