



**University of Central Florida**  
**Mechanical, Materials & Aerospace Engineering Department**

*EMA 3012C*  
*Experimental Techniques in Mechanics and Materials*  
*Fall Semester 2004*

**INSTRUCTOR:**

Dr. Samar Jyoti Kalita (“Dr. Samar”)  
Assistant Professor of Materials Science & Engineering  
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Office Hours: Monday, Wednesday; 9:30-10:20 A.M.  
Other times by appointment

**TEACHING ASSISTANT:**

Mr. Vikas Somani,  
Office: ENG I, Room 157  
E-mail: [somanivikas@rediffmail.com](mailto:somanivikas@rediffmail.com)  
Lab/ Office Hours: M, T, W& R; 12:00-1:50 P.M.

**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; 3:00 – 3:50 P.M. in Classroom building I Room 105. The laboratory schedule for all sections is presented below.

Section 0011	Tuesday	12:00 PM – 1:50 PM	ENG 157
Section 0012	Thursday	12:00 PM – 1:50 PM	ENG 157
Section 0013	Monday	12:00 PM – 1:50 PM	ENG 157
Section 0014	Wednesday	12:00 PM – 1:50 PM	ENG 157

**PREREQUISITES/ COREQUISITES:**

EGN 3365 Structure and Properties of Materials  
EML 3601 Solid Mechanics  
[Please see me immediately if you have not satisfied the above PR/ CR]

**TEXTBOOK:**

Materials Science and Engineering - An Introduction, William D. Callister Jr., John Wiley & Sons Inc., 6th Edition, 2002.

## **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 metals.
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 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, microstructure and metallography, optical and scanning electron microscopy, 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.

At the completion of the course, the students are expected to be fully familiar with 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	5%
Quizzes	15%
Laboratory reports	30%
Midterm Exam I	10%
Midterm Exam II	10%
Final Exam Part A	15% ( <b>Comprehensive, Theory</b> )
Final Exam Part B	15% ( <b>Comprehensive, Practical</b> )

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 and collected. However, only one question will be graded. 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 arrangement will be made on one-to-one basis.
2. Homework solutions will be made available in <http://webct.ucf.edu> on the day of submission after 5:00 PM. No homework will be accepted after the solutions are posted.
3. Feedback and suggestions are always welcome.
4. Class participation is strongly encouraged and attendance is important.
5. 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 question or if you are not convenient 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 Tetelman, Prentice Hall, Englewood Cliffs, NJ.
4. Mechanical Metallurgy, George E. Dieter, McGraw Hill
5. Introduction to Physical Metallurgy, Sidney H Avner, McGraw Hill



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### Lecture Schedule

Week	Date	Topic	Chapter
1	August 24 (T)	Introduction to EMA 3012C	1
	August 26 (R)	Mechanical Properties of Metals: Hardness Testing	6
2	August 31 (T)	Mechanical Properties of Metals: Tensile Testing	6
	September 02 (R)	Mechanical Properties of Metals: Compression Test	6
3	September 07 (T)	Atomic Bonding in Solids	2
	September 09 (R)	Structure of Crystalline Solids	3
4	September 14 (T)	X-ray diffraction (use CD/ book website)	3
	September 16 (R)	Imperfections in Solids	4
5	September 21 (T)	Basics of Metallography (special lecture notes)	
	September 24 (R)	Optical Microscopy	4
6	September 28 (T)	<b>MID-TERM EXAMINATION I</b>	
	September 30 (R)	Electron Microscopy	4
7	October 05 (T)	Phase Diagrams	9
	October 07 (R)	Iron-Iron Carbide Phase Diagram	9
8	October 12 (T)	Iron-Carbon alloys	9
	October 14 (R)	Phase Transformation in Metals	10
9	October 19 (T)	Phase Transformation in Metals	10
	October 21 (R)	Heat Treatment of Steels	10
10	October 26 (T)	Ferrous alloys: Nomenclature	11
	October 28 (F)	Failures: Ductile and Brittle	8

11	November 02 (T)	<b>MID-TERM EXAMINATION II</b>	
	November 04 (R)	Shear and Impact Testing	8
12	November 09 (T)	Fatigue Failures	8
	November 11 (R)	Creep and High Temperature Failures	8
13	November 16 (T)	Corrosion and Degradation of Materials	17
	November 18 (R)	Scanning Electron Microscopy (special lecture)	
14	November 23 (T)	Will be announced in class	
15	November 30 (T)	Will be announced in class	
	December 02 (R)	Will be announced in class	
16	December 07 (T)	Special session of <b>FINAL EXAMINATION 6:00 – 8:50 P.M.</b>	
	December 09 (R)	<b>FINAL EXAMINATION, 1:00 – 3:45 P.M. (Theory, Mandatory)</b>	

Dates for laboratory examination (Mandatory) will be announced in class.

**Time: M-TR 12:00 – 1: 50 PM**

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**Laboratory Schedule**

Lab 1	Rockwell Hardness Testing
Lab 2	Vickers Hardness Testing
Lab 3	Optical Metallography: Basics of Specimen Preparation
Lab 4	Optical Metallography: Microscopic Observation and Analyses
Lab 5	Effect of Heat Treatment on Hardness of Steels
Lab 6	Effect of Heat Treatment on Microstructure of Steels
Lab 7	Estimation of Hardenability by Jominy End Quench Test
Lab 8	Tensile Testing
Lab 9	Shear Testing and Impact Testing
Lab 10	Structure Determination by X-ray Powder Diffraction Method
Lab 11	Scanning Electron Microscopy (no lab report)
Lab 12	Tour of Materials Characterization Facility (MCF) at UCF (no lab report)

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