

# COURSE: EMA 4223

## Title: Mechanical Behavior of Materials

### Catalog Description:

Credits: 3

Plastic deformation and fracture of metals and alloys, ceramics and polymers.

### Prerequisites: EGM 3520

Instructor – John J. Mecholsky, Jr.

- a. Office location: 237A Rhines Hall
- b. Telephone: 352-846-3306 (office)
- c. E-mail address: [jmech@mse.ufl.edu](mailto:jmech@mse.ufl.edu)
- d. Class Web site: login to e-Learning at <https://lss.at.ufl.edu/>
- e. Office hours: M-2;7;R-6

Teaching Assistant – Catherine Sahi

- f. Office location: 116 Rhines Hall
- g. Telephone
- h. E-mail address: [csahi@ufl.edu](mailto:csahi@ufl.edu)
- i. Office hours: ; TBD

Meeting Times – Lecture: T-2,3; 2

Class/laboratory schedule – Three 50 minute lecture periods per week.

Meeting Location – FLG 265

Text: M. A. Meyers and K. K. Chawla, Mechanical Behavior of Materials, Prentice-Hall (1999).

Reference Texts: M.F. Ashby & Jones, Engineering Materials, 1 & 2, Pergamon Press (1980).

R. Hertzberg, Deformation and Fracture of Engineering Materials, 3rd ed., Wiley (1989).

T.H. Courtney, Mechanical Behavior of Materials, McGraw-Hill (2000).

**Online Resources:** <http://mecholsky.mse.ufl.edu/EMA4223/index.htm>

**Software Requirements:** none.

### Course Objectives and Outcomes:

**Purpose:** To introduce the student to problem solving techniques which involve structural materials in adverse mechanical and chemical environments. To demonstrate the common themes of mechanical behavior for different classes of materials.

**Outcomes:** At the end of the course, the student should be able to predict the failure mode and stress of materials subjected to flexural or tensile stresses in uniform or cyclic loading conditions. The student will be able to estimate the time under load for materials that exhibit creep and/or viscoelastic behavior. The student will be able to determine the failure mode and stress levels for plastic deformation and fracture in a brittle manner.

## Topics:

1. Theoretical Strength
2. Elasticity and Viscoelasticity
3. Plastic Deformation
4. Point & Line Defects
5. Interfacial & Volumetric Defects
6. Geometry of Deformation & Work Hardening
7. Fracture: Macroscopic Aspects
8. Fracture: Microscopic Aspects
9. Fracture Testing
10. Creep
11. Fatigue
12. Strengthening and Toughening Mechanisms
13. Martensitic Transformations
14. Intermetallic Materials
15. Composites

**Class Meetings:** 45 lectures

## Grade Determination

|          |      |
|----------|------|
| Tests    | 40 % |
| Quizzes  | 10 % |
| Final    | 35 % |
| Homework | 15 % |

**Grading Scale** - The grading scale is indicated below. Grades are not curved.

|              |     |      |      |     |      |      |     |      |      |     |      |     |
|--------------|-----|------|------|-----|------|------|-----|------|------|-----|------|-----|
| Percentage   | ≥92 | ≥88  | ≥84  | ≥80 | ≥76  | ≥72  | ≥68 | ≥65  | ≥62  | ≥59 | ≥56  | <56 |
| Letter Grade | A   | A-   | B+   | B   | B-   | C+   | C   | C-   | D+   | D   | D-   | E   |
| Grade Points | 4.0 | 3.67 | 3.33 | 3.0 | 2.67 | 2.33 | 2.0 | 1.67 | 1.33 | 1.0 | 0.67 | 0   |

**Any tests missed will count as zero unless a written excuse is submitted before the test. The make-up test will have to be taken at the earliest possible date. Emergencies that arise will have to be documented by the appropriate authority. Attendance is expected. Quizzes will count as a record of attendance. Thus, the penalty for unexcused absences is a lower grade.**

**Homework Assignments (Meyers & Chawla.):** Homework study groups are to be formed. They will consist of at least three students and no more than five students. Grades will be assigned to the group, i.e., everyone in the group will receive the same grade. There will be unannounced quizzes given in class.

| <u>Chapter</u> | <u>Problems</u>                        | <u>Due</u> |
|----------------|--|------------|
| 1              | 1.1, 1.2, 1.15, 1.17, 1.18, 1.19       | Jan. 15    |
| 2              | 2.7*, 2.9, 2.14, 2.24, 2.25, 2.48      | Jan. 22    |
| 3              | 3.1, 3.2, 3.9, 3.14, 3.17, 3.21, 3.29  | Jan. 29    |
| 4              | 4.2, 4.5, 4.9, 4.10, 4.19, 4.24, 4.25  | Feb 10     |
| 5              | 5.2, 5.9, 5.11, 5.12, 5.21, 5.22, 5.29 | Feb 17     |
| 6              | 6.3, 6.8, 6.16, 6.18, 6.19, 6.20       | Feb 24     |

|    |                                       |          |
|----|---------------------------------------|----------|
| 7  | 7.1, 7.2, 7.8, 7.9, 7.16, 7.27, 7.48  | Mar 3    |
| 8  | 8.4, 8.11, 8.13, 8.14, 8.15, 8.17     | Mar 12   |
| 9  | 9.1, 9.6, 9.8, 9.10, 9.11, 9.14, 9.24 | Mar 26   |
| 13 | 13.3, 13.5, 13.6, 13.9, 13.14, 13.20  | April 9  |
| 14 | 14.4, 14.5, 14.11, 14.14              | April 16 |

\* check problem – different book printings have different problem numbers.

Homework is due by 5:00PM of the date listed. Late homework will receive a reduction in grade of ten percent of the total/day (at 5:00 PM of the day in question) up to a maximum of 50 percent.

### Academic Honesty:

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 student at the University of Florida and to be honest in all work submitted and exams taken in this class and all others.

**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.

**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 and 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.

**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.

|  |                         |     |
|--|-------------------------|-----|
| <b>Professional Component Content:</b> | Math and Basic Science: | 20% |
|  | Engineering Topics      |     |
|  | Engineering Science     | 30% |
|  | Design                  | 30% |
|  | General Education       | 10% |
|  | Other                   | 10% |

**Relation to Program Outcomes:**

| Outcome               | Level* | %  |
|-----------------------|--------|----|
| 1. Know fundamentals  | 3      | 19 |
| 2. Apply fundamentals | 3      | 19 |
| 3. Design experiments | 1      | 6  |
| 4. Design Materials   | 3      | 19 |
| 5. Work in teams      | 2      | 13 |
| 6. Communicate        | 2      | 13 |
| 7. Issues in practice | 1      | 6  |
| 8. Society issues     | 1      | 5  |

\*Levels of contribution toward attainment of this ability

1 - Touched upon

2 - Significant

3 - Primary