

## Materials Selection and Failure Analysis

EMA4714 Section 2983

**Class Periods:** T (7)/ R (6-7)

**Location:** Classroom location. TBD

**Academic Term:** Spring 2020

### **Instructor:**

Matthew Zaluzec (Dr. Z)

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Office Hours: Tue (1-2) / Thur (12-1) by appt.

### **Teaching Assistants:**

Please contact through the Canvas website

- TA - [Appajosula Yashodhara Rao "Yashu"](mailto:arao1@ufl.edu), arao1@ufl.edu

### **Course Description**

Philosophy and practice of engineering selection of materials. Case studies in product liability and failure analysis.  
3 Credit hours

### **Course Pre-Requisites / Co-Requisites**

**Prerequisite:** [EMA 4223](#) and [EMA 4324](#)

### **Course Objectives**

“[Invention to Implementation](#)” - Engineers are required to anticipate, innovate and incorporate new ideas in both product development and manufacturing operations. Implementation could range from a single component or application to high volume application (millions) each presenting challenges and opportunities in design and function. Materials engineers, regardless of their individual discipline, will be required to select the right material for the right application at the right time from a large list of manufacturing options with which to fabricate a component or an assembly. The design process can use an existing specification or require an entirely new design based on the intended performance and properties. Additionally, the manufacturing process must be taken into account to ensure quality, reliability and durability of the final product.

As part of various class projects, you will also be required to integrate functionality into your analysis - to understand what it is that the component is supposed to do with respect to the total service environment. A subset of design considerations must be considered, derived from microstructural changes associated with materials processing - forming, molding, heat treating, joining, assembly and changes required to ameliorate wear and friction through the use of engineered surfaces and coatings. Add to this other design constraints such as cost, time, materials availability, environment concerns, etc., and the simple problem becomes a challenge.

This course is intended to expose the student to use of the design methodology from which a procedure can be implemented which will lead to the selection of the optimum material for the particular application being considered. By the time you will have completed this course, you will be able to:

1. Describe, conceptually, analytically and via reverse engineering, how system components work and to model function or performance using scientific and engineering principles learned as part of your undergraduate education.

2. Participate in integrated design activities using fundamentals of “systems engineering”, where performance and behavior have to be analyzed in light of product performance, consumer expectations, durability, and reliability of the design.

3. Gain experience in the selection of materials and optimization of behavior by using a systematic methodology which combines materials properties with the engineering function of the process or product design.

4. Present and justify materials selection effectively both orally and in written form.

5. Select and use appropriate industrial literature and library resources in the solution of materials selection and failure analysis problems. An important element in your thinking will include common sense.

**Materials and Supply Fees**

A midterm project will be assigned to various groups, to be completed as a graded year end assignment, with groups based on specific interest in the following areas of study.

- Metals
- Ceramics
- Polymers
- Electronics
- Biomaterials

**Professional Component (ABET):**

Contribution of the course to meeting the professional components of the ABET-accredited degree, included exams, class projects, homework, and presentation materials.

**Relation to Program Outcomes (ABET):**

Outcome	Coverage*
1. An ability to apply and integrate knowledge of structure, properties, processing, and performance to solve materials selection and design problems within realistic constraints	High
2. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions regarding material selection and/or failures.	High
3. An ability to communicate effectively in both oral and written form with a range of audiences from supervisors & managers, to creating technical presentations for corporate leaders (VP, CEO, CFO, etc)	High
4. An ability to understand the global, societal, and environmental impact of materials engineering solutions.	Medium
5. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.	Medium

6. An ability to function on multi-disciplinary teams, establish goals, identify tasks, meet timelines and analyze risk and uncertainty.	High
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\*Coverage is given as high, medium, or low. An empty box indicates that this outcome is not covered or assessed in the course.

### Required Textbooks and Software

- Engineering Design**

5<sup>th</sup> edition  
George E. Dieter  
Linda C. Schmidt  
McGraw Hill [2009]  
ISBN 978-0-07-339814-3

Recommended for your own reference use are **ASM Handbooks.**

**Materials Selection and Design** ASM International [1997]

**Materials Selection in Mechanical Design**, Pergamon Press [1992] by M.F. Ashby.

### Course Schedule

Weeks 1-8: Engineering Design, Chapters 1-6 & Lecture Notes  
(Class Projects, Quizzes & Homework)

Weeks 9-10: Midterm “Team” Project  
(Quad Charts/Presentation)

Weeks 11-16: Failure Analysis Projects (Undergraduate Materials Lab)  
Final Presentation & Exec Summary

### Attendance Policy, Class Expectations, and Make-Up Policy

EMA4714 is an interactive class, attendance is strongly recommended. Instructor is very flexible and will post all lecture materials for students traveling for interviews, family matters, etc.

This statement is required: Excused absences must be consistent with university policies in the undergraduate catalog (<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>) and require appropriate documentation.

### Evaluation of Grades

Assignment	Total Points	Percentage of Final Grade
Homework Sets	100	10%
Quizzes	100	20%
Midterm Exam	100	30%
Review Paper	100	40%
		100%

Percent	Grade	Grade Points
93.4 - 100	A	4.00
90.0 - 93.3	A-	3.67
86.7 - 89.9	B+	3.33
83.4 - 86.6	B	3.00
80.0 - 83.3	B-	2.67
76.7 - 79.9	C+	2.33

73.4 - 76.6	C	2.00
70.0 - 73.3	C-	1.67
66.7 - 69.9	D+	1.33
63.4 - 66.6	D	1.00
60.0 - 63.3	D-	0.67
0 - 59.9	E	0.00

More information on UF grading policy may be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

### ***Students Requiring Accommodations***

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

### ***Course Evaluation***

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu/evals>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results/>.

### ***University Honesty Policy***

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

### ***Commitment to a Safe and Inclusive Learning Environment***

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Robin Bielling, Director of Human Resources, 352-392-0903, [rbielling@eng.ufl.edu](mailto:rbielling@eng.ufl.edu)
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto:taylor@eng.ufl.edu)
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, [nishida@eng.ufl.edu](mailto:nishida@eng.ufl.edu)

### ***Software Use***

All faculty, staff, and students 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.

### ***Student Privacy***

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

### ***Campus Resources:***

#### *Health and Wellness*

##### **U Matter, We Care:**

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu) so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

**Counseling and Wellness Center:** <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

##### **Sexual Discrimination, Harassment, Assault, or Violence**

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the [Office of Title IX Compliance](#), located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, [title-ix@ufl.edu](mailto:title-ix@ufl.edu)

##### **Sexual Assault Recovery Services (SARS)**

Student Health Care Center, 392-1161.

**University Police Department** at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

#### *Academic Resources*

**E-learning technical support**, 352-392-4357 (select option 2) or e-mail to [Learning-support@ufl.edu](mailto:Learning-support@ufl.edu).  
<https://lss.at.ufl.edu/help.shtml>.

**Career Resource Center**, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

**Library Support**, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

**Teaching Center**, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.  
<https://teachingcenter.ufl.edu/>.

**Writing Studio, 302 Tigert Hall**, 846-1138. Help brainstorming, formatting, and writing papers.  
<https://writing.ufl.edu/writing-studio/>.

**Student Complaints Campus:** [https://www.dso.ufl.edu/documents/UF\\_Complaints\\_policy.pdf](https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf).

**On-Line Students Complaints:** <http://www.distance.ufl.edu/student-complaint-process>.