**EMA 4714**

**Section 2983**

**Materials Selection and Failure Analysis**

**Spring Semester 2019**

**Objectives**

If a scientist invents it's often up to the engineer to implement. Implementation could range from a single component or application to very 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 involve an existing specifications 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. This area would include, among other things: distribution of mechanical forces during operation, duration and magnitude of these mechanical forces and environmental stability of the materials selected (heat, mass, fluid and electrical transport). Beyond that, to complicate matters, there will also be a subset of design considerations which derive from microstructural changes associated with materials processing - forming, molding, heat treating, tempering, annealing and changes from the application of wear and friction reducing 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.

**Syllabus**

- Lectures will be T-7 and R – 6 and 7

- The instructor for this course will be:

Matthew (Matt) Zaluzec, Ph.D

&

Professor John Mecholsky, Ph.D.

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- The textbook is:

**Engineering Design**

5th edition

George E. Dieter

Linda C. Schmidt

McGraw Hill [2009]

ISBN 978-0-07-339814-3

- Strongly recommended for your own reference use is ASM Handbooks, Volume 20, **Materials Selection and Design** ASM International [1997] and "Materials Selection in Mechanical Design", Pergamon Press [1992] by M.F. Ashby.

**- Grading Policy**

Problem Sets ......…................................................... = 10

Quizzes, lowest dropped............................................ = 20

Midterm Exams [1]................................................. = 30

Design Project......................................................... = 40

Total....................................................................... = **100**

**- Grade Scal**e:

92-100 = A 68 – 71.9 = C

88 – 91.9 = A- 65 – 67.9 = C-

84 – 87.9 = B+ 62 – 64.9 = D+

 80 – 83.9 = B 59 – 61.9 = D

76 – 79.9 = B- 56 – 58.9 = D-

 72 – 74.9 = C+ 0 – 55.9 = E