1. Course number and name
    EML 4542 Materials Selection in Design
2. Credits and contact hours
    3 cr, 2.5 contact hours (2 hrs. 30 min. lecture)
3. Instructor's or course coordinator's name
    Instructor: Dr. Eric Hellstrom, Coordinator: Dr. William Oates
4. Text book, title, author, and year
    Materials Selection in Mechanical Design, Ashby, M. F., 2010
5. Specific course information
    a. *brief description of the content of the course (catalog description)*
    This course examines the selection and application of materials predicated on material science and engineering case studies covering most engineering applications.
    b. *prerequisites or corequisites*
    Prerequisites: EML 3012C and senior standing in mechanical engineering
    c. *indicate whether a required, elective, or selected elective course in the program*
    Selected Technical Elective course
6. Specific goals for the course
    a. *Course Outcomes*
        1. Develop specific methodologies for the selection of materials in structural designs [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11]
        2. Analyze the physical principles that underlie the proper production and functioning of mechanical systems [2, 9]
        3. Make use of the some eighteen mechanical, thermal, and wear properties that effect design [3, 4, 5, 6, 11]
        4. Determine the properties of materials from knowledge of their atomic mass, the nature of the interatomic forces, and packing geometry [3]
        5. Make proficient use of material selection charts to check and validate data, and to identify uses of new materials in a materials selection procedure [3, 4, 7]
        6. Derive performance indices for mechanical designs under various types of loading, with or without consideration of shape [5, 6, 7, 8]
        7. Carry out an actual design task, using quantified design attributes, objectives, and constraints, culminating in a primary design equation and the derivation of a material performance index [5, 6, 7, 8]
        8. To optimize performance in terms of weight, size, and cost of a load bearing component by considering the shape of sections [5, 6, 7, 8]
        9. Identify and specify the processing methodologies required in the transition from a design into a manufactured product [9]
        10. Use alternate materials and consideration of shape to turn around unfeasible designs [9, 10]
        11. Design a product or component using rigorous design and materials selection procedures and fully quantified parameters in the design equations [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12]
        12. Present to an engineering audience the results of a design effort [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12]

        Numbers refer to Course Objectives below, e.g. for course outcome 2, [2, 9] refers to course objectives 2, 9.

b. *Course Objectives and Relation to Student Outcomes*

1. The difference between mechanical and industrial design and the basic design types: original, adaptive, and variant [6, 8]
2. That design is an iterative process involving conceptualization, design embodiment, and design detailing [2]
3. The classes of engineering materials and their design limiting material properties [2]
4. The use of material selection charts and how to read and interpret them in a procedure for materials selection [2, 5, 10]
5. How to derive, within the limits set by the design objective(s) and the governing constraints, a primary design equation containing terms relating to the functional requirements, the geometry of the component, and the material properties [1, 2, 3, 5]
6. The procedure to derive a performance index for components loaded in tension, bending, twisting, and buckling as well as in various elastic and thermal designs [1, 3, 5, 10]
7. The use of case studies to become more proficient in the identification of the (initially) best parameter in a new design or in making changes in materials to improve on an existing design [1, 3, 5, 6, 8]
8. The derivation of macroscopic and microscopic shape factors for various types of loading and performance indices, to include shape [1, 3, 5]
9. The impact of processing methodologies in turning the as-designed concept into a manufacturable product at a cost the market can absorb [3, 5]
10. The evolution of materials in the design process, which has made for the transition from a function driven design to a materials driven design [3, 5, 8, 9]
11. The use of materials databases [5, 10]
12. How to write and present a professional engineering report [6, 7]

Numbers refer to Departmental Student Outcomes, e.g. for course objective 1, [6, 8] refers to student outcomes 6, 8.

7. Brief list of topics to be covered
    - The Design Process
    - Engineering Materials and their Properties
    - Materials Selection Charts
    - Materials Selection without Shape
    - Case Studies Involving Materials Selection without Consideration of Shape
    - Selection of Materials and Shape
    - Case Studies of Designs in which both the Material and its Shape Play a Role
    - Materials Processing and Design
    - Case Studies Emphasizing Choice of Processing Method(s) Critical to System Performance
    - Material Data Sources, Pros and Cons
    - Materials, Aesthetics, and Industrial Design