MTSC 4060: MATERIALS SELECTION AND PERFORMANCE

Spring Semester, 2013 - 3 credits

Class Instructor: Dr. Srinivasan G. Srivilliputhur, **Office**: C-132C, Discovery Park.

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Class Website: http://www.mtse.unt.edu/Srivilliputhur/Notes.html

Lecture notes, assignments, etc. will be posted here as PDF files.

Office Hours: If I am in my office, I am available. Also, you can e-mail me.

Lecture: Tuesday/Thursday 12:30 PM – 1:50 PM, Discovery Park Room D-212

Textbook: M. F. Ashby, Materials Selection in Mechanical Design, Elsevier, 2011, ISBN: 978-1-85617-663-7

Supplementary Reference: M. Ashby, H. Shercliff, D. Cebon, Materials – engineering, science, processing and design, Elsevier, 2010, ISBN: 978-1-85617-743-6

Catalogue data: Integration of structure, properties, processing and performance principles to formulate and implement solutions to materials engineering problems.

Prerequisites: ENGR 3450, MTSE 3010. The student must be familiar with fundamentals of materials science – crystal structure, bonding, and processing. We will emphasize concepts and use "case studies" format.

Time Distribution: One 2-hour class and one 1-hour class per week

Objectives: To provide students the ability to: (a) understand how materials structure, properties, and processing interact to affect their performance. (b) devise, design and conduct computational exercises to explore the essential elements of materials science and engineering in materials performance using case study format. (c) We will use CES EduPack Software from Granta Design to explore challenges in materials selection using a number of practical problems. ABET criterion 3 outcomes a, b, c, d, e, g, h, i, k.

***Very Tentative* Course Outline: (No classes on March 5 and 9, Travel to TMS Annual Meeting; Please use this time to work on your course project)**

I. Introduction to Materials Selection and Design (3 weeks)
   - Review of engineering materials and their properties
   - Organizing materials and processes
   - Strategic thinking: matching material to design
   - The design process

II. Materials Property Charts, and Material and Process Selection Basics (3.5 weeks)
   - Material indices
   - Structural index
   - Selection strategy including computer-aided selection

Selection with multiple constraints and conflicting objectives
Processing for properties and systematic process selection

III. Case Studies (8 weeks)

Materials selection for strength-limited, fracture-limited, toughness-limited design; Ashby property charts
Materials selection for electric, magnetic, and optical design
Materials selection for wear, friction, and creep applications
Designing hybrid materials
Materials and environment – materials lifecycle, energy footprint, eco-attributes, eco-selection, and eco-audit

Grading Plan:

(1) Class Participation and Homework (5-7 total)	10%
(2) Materials Selection Exercises Using CES EduPack (8-10)	20%
(3) Class Project	20%
(4) Midterm Exam	25%
(5) Comprehensive Final Exam	25%

Professional Component Content:

Engineering Design: 2.5 credits or 80%.
Engineering Science: 0.5 credits or 20%.

Design Component Content:

The students will develop a fundamental understanding of systematically analyzing materials and processes and down select them to identify optimal combination(s) that best matches the requirements of a given design.

Relationship to Program Objectives:

This course is integral to Program Objectives 1 and 2. It provides students opportunities (a) to understand and apply fundamental concepts related to materials structure, properties, and processing to materials performance and applications, and (b) to recognize new design opportunities with materials and communicate their ideas with their peers. A materials electronic database and selection software will be used to educate the students on these concepts

***Makeup Exam Policy*:** A student missing a scheduled exam due to unavoidable reasons such conference travel, sickness, etc. must *email* the instructor to get permission and arrange for a makeup exam.

Class Attendance is Mandatory. Please notify the instructor by email if you have to miss a class.

***Academic Integrity* –** Plagiarism and cheating will result in an overall **F grade (Fail)**. Please consult the UNT academic conduct manual for the definition of plagiarism and related policies. When in doubt please ask me.

MTSC 4060 Project Guidelines

1. **20 points total for both your written report and oral presentation.**
2. Self-organize into teams with two members each.
3. Your written report should not exceed 5 pages (1.5 spaced, 12 point Symbol and/or Times New Roman fonts). Figures, tables and graphs are *not* counted towards page limit.
4. Follow the writing guidelines of Ashby posted on the class webpage.
5. ***CAUTION***: follow the timeline below; pace your effort and don't wait until the deadline.
6. Timeline:

    a. *Selection of topic*: *Email* the instructor by 02/28/2013. You should select a system or sub-system for mechanical design analysis and materials selection. You may take an available design analysis of a system from literature and just focus of materials selection and materials design (hybrid materials).

    b. *Project analysis*: Preliminary analysis and survey should be finished by 04/01/2013 and discuss with the instructor with a few references. The student must have a fair idea of the topic by this time. A computerized literature search of the topic should be conducted and a computer printout should be shown to the instructor during discussion with instructor.

    c. *First draft*: Due by 04/11/2013. The first draft will be graded and given back with feedback for possible improvement by 04/18/2013.

    d. *Final paper*: Due by 04/25/2013. The final paper should be emailed to the instructor as *both* Word and PDF documents. Also, a set of at least 3 key papers/documents should be handed manually in a folder to help grade reports.

    e. *Presentations* will be on 04/30 and 05/02/2013. Each will be of ten Minute duration with <10 transparencies. E-mail both PDF and PPTX presentation files at least one day before your talk.

MTSC 4060 Project Checklist

1. Project Statement or Objective – Have you clearly articulated this?
2. List of components/subsystems
3. Design Requirements – Have you developed the design requirements table (function, constraint, objective, free variable) for each component?
4. Model for Each Component – Have you developed a model or taken a model from literature?
5. Identify the appropriate Materials Indices
6. Materials Selection Chart – use the CES software to
    a. Develop Materials property charts
    b. Identify Multiple constraints and penalty functions
7. Development of Materials Selection Table – Have you included a short list of candidate materials with relevant property and index columns?
8. Materials Selection Postscript
9. Process Selection – What processes can be used with the materials selected in step 8?
10. Shape Considerations – Will your shape considerations dictate material and process choice?
11. Hybrid Materials – Will hybrid materials approach provide a better choice? If yes, develop it.
12. Conclusions – Distill steps 8-11 to make conclusions and final recommendations.
13. References

Prepared by: Srinivasan G. Srivilliputhur Date: January 14, 2013