MTSC 4060: MATERIALS SELECTION AND PERFORMANCE

Spring Semester, 2016

Credits/Contact: 3 Credits, TU/TR 1:00PM-2:20PM, NTDP D-212

Office Hours: Mon 1-3PM, Wed 9AM-11AM or by appointment.

Class Instructor: Dr. Srinivasan G. Srivilliputhur, **Office**: Discovery Park C-136C.

Email: srinivasan.srivilliputhur@unt.edu; **Phone**: 940-369-8273

Class Website: Lecture notes, assignments, etc. will be posted on Blackboard.

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, 2014, ISBN: 978-0-08-099434-5

Other Information

(a) Brief description of the content of the course (catalog description)

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

(b) Prerequisites or co-requisites

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

(c) Whether a required or elective course in the program. Required

Specific Goals: *(a) Specific outcomes of instruction* To provide students the ability to: (a) understand how materials structure, properties, and processing interact to affect their performance using materials datanbases. (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) Students will learn to recognize new design opportunities with materials and communicate their ideas with their peers by working on an independent project, and summarizing their work in the form of a term paper and a class presentation. We will use CES EduPack Software from Granta Design to explore materials selection using practical problems.

(b) Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course. This course addresses ABET Criterion 3 Student Outcome(s): a, b, e, g, i, k

Tentative Course Outline

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 and structural indices
   - 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:	(1) Class Participation and Homework (4 total)	10%
	(2) Materials Selection Exercises Using CES EduPack (7)	20%
	(3) Class Project	20%
	(4) Midterm Exam (During your class period on **03/15/2016**)	25%
	(5) Comprehensive Finals (10:30A–12:30P, Thursday, **05/12/2016**)	25%

Relationship to Program Objectives: This course will help students to (a) *understand* and *apply* fundamental concepts related to materials structure, properties, and processing to materials performance and applications, and (b) *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 who misses exam(s) due to unavoidable reasons such conference travel, sickness, etc. must show proof such as doctor's and/or advisor's note to the instructor to get permission and/or 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 consult the instructor.

Make up Lectures. The instructor will make up any lecture(s) he misses due to conference travel and emergencies on a Friday selected in consultation with you.

Late Assignment Policy – Homework and other assignments must be turned in <u>before</u> their deadline. **No credit will be given for late submissions**.

MTSC 4060 Project Guidelines

1. **20 points total for both your written report and oral presentation combined.**
2. Self-organize into *three member teams*. Build a diverse team for success.
3. Follow the writing guidelines of Ashby placed in your reading list folder on the Blackboard.
4. ***TIMELINE***:
   a) ***Topic***: This class will study materials selection for automobile airbag safety system. First, you will investigate the current state-of-the-art for this system. Next, you will explore developing a similar system to protect the President on Air Force One (and/or a passenger on a small jet plane). This part of your project should be devoted to exploring stresses experienced when a plane crashes and whether such a protection system is even feasible given the currently available materials.
   b) **Team Expectation**: Each team should interview an outside expert to get feedback. So it is important you start early and not wait till the last minute.
   c) *Email* the instructor by 02/18/2016. You should select an airbag system or sub-system for materials design analysis and selection. Analyze an available a system of interest, focus on improving materials selection and design.
   d) ***Project Analysis***: Preliminary analysis, a set of 3 key papers, and survey should be finished by 03/22/2016 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.
   e) ***First Draft***: Due by 04/14/2016. The instructor will give feedback by 04/21/2016.
   f) ***Final Paper***: Due by 05/03/2016. Each project team must submit their project report through the class portal on Blackboard via Turnitin software. Papers with plagiarized components will receive a score of zero. Also, hardcopies of your report and a set of 3 key papers/documents should be submitted in a folder.
   g) ***Presentations*** will be on 05/03/2016 and 05/05/2016. Each group talk will be of ten-minute duration with ~10 slides. E-mail both PDF and PPTX files at least one day before your talk.
5. Your written report should not exceed 10 pages (single spaced, 12 point Symbol and/or Times New Roman fonts, and 1-inch margins around). **Legends and labels in the embedded figures should have at least a font size 12. Use only metric/SI units.**
6. Abstract, literature review, figures, tables, graphs, and references are *not* counted towards the 10-page limit.

CAUTION: Follow the timeline below; pace your effort and don't wait until the deadline. **There will be a penalty for not following the above guidelines.**

MTSC 4060 Project Report Components

1. Project Statement or Objective – Have you clearly articulated this?
2. List of components/subsystems currently used. What are their (dis)advantages? What alternate design strategies and materials can be explored?
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/Citations.

***CAUTION*: There will be a penalty for not following the above guidelines.**

Prepared by: Srinivasan G. Srivilliputhur Date: January 15, 2016.