MTSE 4060: MATERIALS SELECTION AND PERFORMANCE

Spring Semester, 2018

Credits/Contact: 3 Credits, TU/TR 10:00AM-11:20AM, NTDP D-212

Office Hours: Wed 9AM-10AM or by appointment.

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

Textbook: M. F. Ashby, Materials Selection in Mechanical Design, Elsevier, 2011, ISBN: 978-1-85617-663-7
Supplementary Material: 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 application problems. We will use "case studies" format.

(b) Prerequisites or co-requisites

ENGR 3450, MTSE 3010. The student must be familiar with fundamentals of materials science – crystal structure, bonding, and processing.

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

Specific Goals:

(a) Specific outcomes of instruction

(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)

Specific Course Learning Outcome	ABET Outcome						
	1	2	3	4	5	6	7
1. Understand how structure, properties, and processing affects performance	X						
2. Use digital materials' databases and design tools such as CES EduPack Software from Granta Design	X						X
3. Design and conduct computational exercises to explore materials performance via case studies.	X	X		X			
4. Recognize new design opportunities in materials by working on a team project and communicate their ideas with peers.	X		X		X		

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) HW (3) + Materials Selection Using CES EduPack (5)	20%
	(2) Project Poster Presentation	15%
	(3) Project Report	15%
	(4) Midterm Exam (During your class period on **03/20/2018**)	25%
	(5) Comprehensive Finals (8:00A–10:00A, Thursday, **05/10/2018**)	25%

Travel: I will be on conference travel during spring break (from March 11-15, 2018).

Class Objectives: This course will help (a) *understand* and *apply* fundamental concepts related to materials structure, properties, processing, performance, and applications, and (b) *recognize* new design opportunities with materials and communicate ideas with their peers. A materials electronic database and selection software will be used.

***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 related policies.

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

Late Assignment Policy – Homework and other assignments must be turned in by their deadline. **No credit will be given for late submissions**.

Cell Phone Use Policy – You must put your phone away during class.

MTSE 4060 Project Guidelines

1. **30 points total for both your written report and poster presentation combined.**
2. You are assigned to *two member teams*.
3. Follow the writing guidelines of Ashby placed in your reading list folder on the Blackboard.
4. ***TENTATIVE TIMELINE***:
   a) ***Topic***: This class will study *design, materials selection, and manufacturing* of helmets to increase their ability to prevent concussion and brain damage in football players. First, you will investigate the mechanisms of impact and brain damage, current state-of-the-art for the helmets, identifying its strength and weaknesses in preventing brain damage. Next, you will explore new helmet designs and underlying science to enhance protection. This part of your project should be devoted to exploring stresses experienced by helmet, skull, and brain under impact and whether a perfect helmet protection system is even feasible given the currently available materials. Lastly, you will investigate the ideal processing method to manufacture the accessory profitably.

   b) **Team Requirement**: Each team should interview at least one outside materials expert to get feedback. Talking to a head trauma doctor will enhance your project. So, it is important that you do not wait till the last minute. This component has a 20% weight towards your project grade and the details of your discussions must be summarized in your written report.

   c) *Email* your project outline to the instructor by 02/06/2018. Analyze and focus on product design, stress-mitigation, materials selection, processing, and manufacture.

   d) ***Project Analysis***: Preliminary analysis, a set of 3 key papers, and survey should be finished by 03/13/2018 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 04/13/2018. Meet the instructor for feedback by 04/20/2018.

   f) ***Final Paper***: Due by 05/04/2018. Each team must submit their written project report through the BlackBoard portal created by the instructor. This report will be automatically checked by Turnitin for plagiarism. Papers with plagiarized components will receive a score of zero. Also, a set of 3 key papers/documents should be submitted in a folder.

   g) ***Poster Presentation*** *on* 9AM on 05/04/2018***:*** Each team will display their poster in the MTSE lobby for a discussion. E-mail PDF files the day before your poster presentation.
5. Your written report should not exceed 15 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 be font size 12 and be clearly legible. Use only metric/SI units.**
6. Abstract, literature review, figures, tables, and references are *not* counted for the 15-page limit.

CAUTION: Pace your efforts, follow the above guidelines, and don't wait till the deadline.

MTSE 4060 Project Report: Some Suggested 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. Choice of appropriate/optimal materials microstructure.
12. Hybrid Materials – Will hybrid materials approach provide a better choice? If yes, develop it.
13. Conclusions – Distill steps 8-11 to make conclusions and final recommendations.
14. References/Citations.

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

MTSE 4060 Project Teams

Team-1. Haley Barnes and Vincent Callirgos.

Team-2. Faith Gantz and Shomari Cotton

Team-3. Whitley Green and Adam Cunningham

Team-4. Jessica Lanier and David Flannery

Team-5. Laura Mello and Hunter Lide

Team-6. Jessica Reeder and William Eiland

Team-7. Kaylie Sheehan and Tyler Hunt

Team-8. Dofia Sheikh and Neil Macdonald

Team-9. Sheena Valentin and Roman Gruszecki

Team-10. Sammy Zellner and Brandon Ohl

Team-11. Garrett Simpson and Spenser Taylor

Team-12. Ty Thomas and

Note: Each student will rate their team member's contribution to team-cohesion and quantity and quality of effort during their final exam by answering a survey.

Prepared by: Srinivasan G. Srivilliputhur Date: January 14, 2018.