MTSE 4060: MATERIALS SELECTION AND PERFORMANCE

Spring Semester, 2019

Credits/Contact: 3 Credits, Mon/Wed/Fri 1:30 PM-2:20 PM, NTDP D-202

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 (2) + Materials Selection Using CES EduPack (5)	20%
	(2) Project Poster Presentation	15%
	(3) Project Report	15%
	(4) Midterm Exam (During your class period on **03/20/2019**)	25%
	(5) Comprehensive Finals (10:30A–12:30P, Saturday, **05/04/2019**)	25%

Travel: The UNT Registrar's Office decides the date of your final exam. It cannot be changed easily. So, please do not make plans to leave for your vacation before the final exam.

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. Attendance is expected for each class because your participation in discussions is crucial. If you are unable to make a class, please email me. 10 or more unexcused absences will lead to a student being dropped from the class. Excused absences include illness, conference travel, family emergency, religious holiday, and any other unplanned difficulty as determined by the instructor. Five unexcused absences will result in a 5-point deduction from your final course grade. Each additional unexcused absence will result in an additional point deduction in your final course grade (up to 9 absences). While traffic and other issues present difficulties getting to Discovery Park before class, being more than 15 minutes late for class is disruptive and will be considered "being late." Consequently, six unexcused late

arrivals will result in a 0.5-point deduction from your final course grade. Each additional late arrival will result in an additional 0.5-point deduction in your final course grade.

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.** Each student will rate their team member's contribution to team-cohesion and quantity and quality of effort in their final exam. This rating will be factored into your project grades.
2. You self-assemble into *two member teams*. Email me your team membership info on 01/21/2019.
3. Follow the writing guidelines of Ashby placed in your reading list folder on the *Canvas*.
4. ***TENTATIVE TIMELINE***:
   a) ***Topic***: Each team will discuss and select a project topic that will study *design, materials selection, and manufacturing* of a product. The topics selected by each team must be emailed to me on 01/30/2019. For example, one of your preceding classes studied the design of better helmets to reduce Football related head injuries. First, they investigated 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, they explored new helmet designs and underlying science to enhance protection. This part of their project was 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, they investigated the optimal processing method(s) to manufacture the helmets profitably.
   b) **Team Requirement**: Each team should interview at least one outside materials expert to get feedback. This 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. Dr. Rick Reidy cannot be this so-called external expert.
   c) *Email* your project outline to the instructor by 02/08/2019. Analyze and focus on product design, preliminary materials selection, processing, and manufacture.
   d) ***Project Analysis***: Preliminary analysis, a set of 3 key papers, and survey should be finished by 03/20/2019. Each team must meet with the instructor in person to discuss their project outline. The students must have a fair idea of their topic by this time.
   e) ***First Draft***: Due by 04/15/2019. Meet the instructor in person for feedback.
   f) ***Final Paper***: Due by 05/04/2019. Each team must submit their written project report through the Canvas portal created by the instructor. This report will be automatically checked for plagiarism. Papers with plagiarized components will receive a score of zero.
   g) ***Poster Presentation*** *during your class period* on 04/29/2019 and 05/01/2019***:*** Each team will display their poster in the MTSE lobby for a discussion.
5. Your 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.** 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.**

Prepared by: Srinivasan G. Srivilliputhur Date: January 14, 2019.