MTSC 4060: MATERIALS SELECTION AND PERFORMANCE

Spring Semester, 2014

Credits/Contact:  3 Credits, Tu/Th 10:00 AM-11:20 AM Discovery Park Room D-212
Office Hours:  Mon 1-3PM, Wed 10AM-12PM, by appointment, or answer via email.
Class Instructor:  Dr. Srinivasan G. Srivilliputhur, Office: C-136C, Discovery Park.
Email:  srinivasan.srivilliputhur@unt.edu; Phone: 940-369-8273
Class Website:  Lecture notes, assignments, etc. will be posted on course blackboard.


Specific Course 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 emphasize concepts and use “case studies” format.

(c) Indicate whether a required, elective, or selected 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. (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 challenges in materials selection using a number of 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 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:**
1. Class Participation and Homework (3 total)  
   - 10%
2. Materials Selection Exercises Using CES EduPack (8)  
   - 20%
3. Class Project  
   - 20%
4. Midterm Exam  
   - 25%
5. Comprehensive Final Exam  
   - 25%

**Relationship to Program Objectives:** This course provides students opportunities 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 missing a scheduled exam due to unavoidable reasons such as 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 consult the instructor.

**Make up Lectures.** There will be no lectures on January 16th, February 18th and 20th, April 29th, and May 1st due to conference travel. Work on your course project during my absences in January and February. I will have make up lectures on two Fridays selected in consultation with you.
Choose one of the following two tracks for your class project.

(A) Project Track-1: The US National Academy of Engineering (NAE) is celebrating their 50th Anniversary in 2014. To commemorate this milestone is organizing a video contest on how engineering has transformed society in the past 50 years and how it is set to do so in the next 50 years. The details are given at [http://www.nae.edu/e4u/](http://www.nae.edu/e4u/). The deadline for this contest is March 31, 2014. The deadline for your video submission and evaluation by your peers, if you chose to participate in this contest, is March 15, 2014. Your topic is also focused to, “What advances in materials science has transformed society and what future advances will have a revolutionary effect?”

(B) Project Track-2

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 7 pages (1.5 spaced, 12 point Symbol and/or Times New Roman fonts).
4. Figures, tables, graphs, and references are *not* counted towards the 7-page limit.
5. Follow the writing guidelines of Ashby that is in your reading list.
6. **CAUTION:** follow the timeline below; pace your effort and don’t wait until the deadline.
7. **TIMELINE:**
   a. *Selection of topic:* Email the instructor by 02/28/2014. 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 04/01/2014 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 04/11/2014. The first draft will be graded and given back with feedback for possible improvement by 04/18/2014.
   d. *Final paper:* Due by 04/25/2014. 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 05/02/2014. 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 (Track-2)

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 06, 2014.