

MSE 1030 Material Selection

Course Syllabus

Fall 2020

Description

Selecting a material is one of the most critical design decisions an engineer can make. With the advent of new age materials and evolving technology in manufacturing processes, there is a tremendous opportunity for innovation in design by utilizing the materials in products that provide greater performance at lower cost. In this course, students will learn – with the help of rich visuals, how to evaluate the various factors that impact material selection. The course also includes real world case studies in materials selection for different products, based on their design specifications. This course provides a methodology for selecting materials for a given application. It aims to provide an overview of the different classes of materials (metal, ceramic, polymer and composites) and their properties including modulus, strength, ductility, toughness, thermal and electrical conductivity, and resistance to corrosion in various environments. Students will also learn how materials are processed and shaped (e.g., injection molding, casting, forging, extrusion, welding, grinding, and polishing), and will explore the origins of the properties. The course accomplishes the materials selection objective in part through example applications and in part using CES EduPack software.

Additional topics include economics, codes and standards, environmental and safety regulations and life cycle analysis where applicable. The course incorporates a project where virtual teams work to provide material selection for a specific application problem.

Course Summary

Material selection is a step in the process of designing any physical object. In the context of product design, the main goal of material selection is to choose appropriate eco-friendly material for given application with best combination of properties, easy fabrication process, and minimal cost. This course will provide information for each student to learn best practices of material selection from the major sources around the world. Mechanisms will be studied and assessments will be conducted to practice the skills obtained.

The requirement to current engineer is a global vision of the world and professional success demands new approaches to problem solutions from specialists. Engineers and researchers alike must be familiar with the scope of materials, technologies, properties, methods etc. They possess the ability to source, evaluate and transfer technology from the very first step to the marketplace. This new profession is a sign of the increasing importance of engineering and research in global economy.

The course assumes that the student has prerequisite knowledge of physics, chemistry, physical metallurgy, mechanical and physical properties of materials.

Learning Outcomes

By the completion of this course, students will be expected to:

- ✓ List the main categories of material properties that must be considered in design
- ✓ Summarize the service requirements that affect materials selection
- ✓ Describe the materials selection process
- ✓ List the resources available to aid in the materials selection process

- ✓ Explain the process of materials selection and be able to use available tools for making decisions on materials selection for engineering applications.
- ✓ Develop optimization equations for selection of materials for defined design projects.
- ✓ Use methods of design on a base of minimization of conflict between environmental impact, total costs and functional characteristics of new items.
- ✓ Use material property plots to identify the best performing materials for a given application.
- ✓ Recognize the importance of environment with respect to energy consumption and recyclability of engineering components in selection of materials and fabrication process.
- ✓ Recognize the need to undertake lifelong learning.
- ✓ Demonstrate the ability to work as a team member, plan and make decisions through effective communication and write a professional engineering report.

Course Content

- ✓ The Importance of Engineering Materials
- ✓ Forming Engineering Materials from the Elements
- ✓ Materials Properties Including Chemical, Physical and Mechanical, Tribology and Corrosion in Engineering Materials
- ✓ Metal and Alloys, Steel Products, Heat Treatment of Steels, Carbon and Alloy Steels, Tool Steels, Stainless Steels, Cast Iron, Cast Steel and Powder Metallurgy Materials
- ✓ Copper and Its Alloys, Aluminum and Its Alloys, Nickel, Zinc, Titanium, Magnesium and Special Metals
- ✓ Polymeric Materials, Polymer Families, Plastic and Polymer Composite Fabrication Processes, Selection of Plastic/Polymeric Materials
- ✓ Ceramics, Cermets, Glass, and Carbon Products
- ✓ Composites
- ✓ Surface Engineering
- ✓ Nanomaterials
- ✓ Methodology of Material Selection
- ✓ Materials Selection Case studies and Individual Project for Students for Material Selection
- ✓ Materials, Environment and Sustainability

Course structure

Delivered through a combination of lectures and case study projects presentation

Reading List

1. Engineering Materials: Properties and Selection, 9/e, Author(s): Kenneth G. Budinski and Michael K. Budinski, ISBN:9789332574045, Pearson Education, 2017.
2. Materials: Engineering, Science, Processing and Design, Mike Ashby, Hugh Shercliff, and David Cebon, 4/e, ISBN: 9780081023761, Butterworth-Heinemann, Elsevier, 2019.
3. Software: CES EduPack, Granta Design Ltd.
(<https://www.grantadesign.com/education/ces-edupack/>)

Grading

Homework Assignments 20 %

Project Presentation 30%

Final Exam 50 %

Schedule: Online Lectures: Every Tuesday from 08/09/2020 to 29/12/2020, 13:50-16:25

Exam date: Tuesday, 13:50-16:25, 06/01/2021

Instructor Associate Professor Ali Davoodi, ali.davoodi@scupi.cn

Teaching Assistant Guodong Niu, niuguodong@stu.scu.edu.cn

When emailing the instructor or TA, include “**MyName2020F-MSE_1030**” in the subject field of your message. Use your university email account; mail from other accounts might be stopped by the SCU spam filter.

Web Site

This course uses the Blackboard and Zoom online video conference system; the web site is

<https://learn.scupi.cn/>

the online course will be arranged by TA on Zoom platform.

(Note: the **https** is important, otherwise it may not load.) There you will find the course syllabus, homework assignments, and other materials. Current announcements and assignments will be posted on the home page. All assignments will be uploaded through the Blackboard system. Please check the class page frequently.

Class Format

This course is taught using a combined lecture, reading, review and discussion format. The lecturer may ask questions to as many students as possible and encouraging critical reading of published papers in related field.

It is imperative that you come to class prepared. This will generally involve reading all posted literature and viewing tutorial videos. This is a three credit hour class, which means you should expect to devote at least 9 to 12 hours of effort outside the scheduled class time every week.

Homework Assignments

Assigned homework problems will be posted on Blackboard with details information. These are to be completed and turned by the following week. You may work with other people on homework, but all write-ups must be individual efforts. Homework will be graded on a 0-100 point scale.

All work will be submitted electronically through the Blackboard system. Late homework will not be accepted.

Unless specifically requested, emailed homework will not be accepted.

Please adhere to these homework guidelines:

- Your assignment must be typeset using Word and submitted electronically through Blackboard.
- Put your name, ID number (last four digits), and class section at the top of the first page, e.g., “**MyName2020F-MSE_1030**”

All the homework scores will be used in your grade computation. Unless otherwise indicated, you can work with your fellow classmates in the class, but you must submit a distinct and independent write-up to receive credit.

If you are sick or have a compelling emergency that prevents you from turning in the homework on time, email Prof. Ali Davoodi.

If you believe an error has been made in the grading of an assignment, bring it to the attention of your TA within one week of its return.

Contact instructor or teaching assistant

If you do not understand something, and talking to your classmates does not help, then you should be seeking help from the instructor or teaching assistant. We are available via email to schedule an online time for discussion.

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