ME/MSE 4790 Materials Selection and Design

Catalog Description

ME/MSE 4790 Materials Selection and Design (3-0-3)
Prerequisites: COE 3001 Deformable Bodies
Principles of selecting materials and processes for engineering applications. Methodologies for designing new materials and conceiving hybrid solutions.

Course Outcomes

Apply systematic materials selection methods to identify appropriate materials for engineering design.
Evaluate the relationships among material properties, processing methods, and performance in engineering components.
Select manufacturing processes that satisfy design requirements for geometry, properties, and cost.
Analyze materials selection and design problems involving multiple constraints and trade-offs, including economic, environmental, and sustainability considerations.
Formulate and justify materials design solutions, including hybrid and novel material concepts.

Instructor

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Required Textbook

Ashby, Michael F., *Materials Selection in Mechanical Design*, 5th Edition, Butterworth-Heinemann, 2017.

Required Software

Ansys Granta EduPack, www.ansys.com/products/materials/granta-edupack
Software is available to students as a free download through the College of Engineering (COE). See https://gatech.service-now.com/home?id=kb_article_view&sysparm_article=KB0028918 for download and installation instructions (Note: Need to be on campus network or VPN). Mac Users: You will need a Windows emulator installed. Alternatively, the COE and Woodruff School maintain VLABs which contain this software accessible from any location by visiting: https://mycloud.gatech.edu/. Select "DESKTOPS" and then either "COE-20xx" or "ME-20xx". The application is labeled *Granta EduPack*.

Topics Covered:

1. Engineering materials and their properties
2. Introduction to materials selection software
3. Material property charts
4. Strategy for materials selection
5. Materials selection without shape
6. Materials selection involving multiple constraints and/or conflicting objectives
7. Selection of material and shape
8. Hybrid materials
9. Bio-inspired materials
10. Introduction to materials design
11. Material processes and process selection
12. The material life-cycle and environment-friendly selection
13. Failure analysis and materials selection for durability
14. Aesthetics and industrial design

Grading

20% **Exam 1**
20% **Exam 2**
15% **Exam 3** *(online)*
15% **Homework**
30% **Project**

A > 90, **B** > 80, **C** > 70, **D** > 60

Canvas

All lecture slides, handouts, homework solutions, your scores, and much more can be found on Canvas.

Attendance

This will be an active classroom, where you will be expected to participate. I have noticed a drastic difference in the exam performance between students who regularly attend class and those who don't.

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. Please review Georgia Tech's Honor Code and the student Code of Conduct. Any student suspected of cheating or plagiarism on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Core IMPACTS

Not applicable

Accommodations

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services (404-894-2563) as soon as possible to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Student-Faculty Expectations

At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. The Student-Faculty Expectations articulate some basic expectations that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.

Collaboration and Group Work

You are allowed to work in groups on all homework and out of class projects, but any work you turn in must be written in your own hand and be clear on your solution approach and resources used. Exams are to be your own work.

Use of Generative AI

Generative AI tools (e.g., ChatGPT, Gemini, Copilot, and similar systems) may be used in this course as aids to support learning, exploration, and design. When used appropriately, these tools can assist with brainstorming, conceptual understanding, code development, data analysis, and communication.

However, the following expectations apply:

- **You remain fully responsible for all submitted work.** Any material produced with the assistance of AI must be understood, verified, and critically evaluated by you.
- **AI may not be used as a substitute for your own thinking.** Submitting AI-generated solutions without comprehension, modification, or validation is not acceptable.
- **Transparency is required.** Any substantive use of generative AI must be clearly acknowledged. This includes a brief description of how the tool was used (e.g., ideation, debugging, drafting text, etc.).
- **Engineering judgment is essential.** AI-generated results may be incomplete, incorrect, or misleading. You are expected to apply sound engineering principles to assess and validate all results.
- **Exams remain individual work.** Use of generative AI is not permitted during exams unless explicitly stated otherwise.

Appropriate use of generative AI in this course is intended to **enhance your ability to think, design, and evaluate engineering solutions**, not replace those skills. In materials selection and design, the ability to frame problems, evaluate trade-offs, and justify decisions is essential; generative AI should be used to support—not replace—these core engineering competencies.

Extensions, Late Assignments, & Re-Scheduled/Missed Exams

Late homework will be penalized accordingly. Make-up exams are given for illness, approved Institute activities, or religious observances.