

MSE 1030: Materials Selection **Syllabus for 2026 Fall**

Instructor: Dr. Yingjie Wu (Office: SCUPI N405; Email: yingjie.wu@scai-ji.cn)

Lecture: 3 Credits, Thursday, 1:50 pm - 4:25 pm, SCUPI S502

Office Hours: Friday, 9:15 am – 11:55 am, SCUPI N405

TA: N/A

QQ Group: 1055649577

Prerequisites: ENGR 0022

Course Description:

This course teaches the essential methodology for materials selection in mechanical design processes, including: (i) design process and consideration, (ii) criteria for materials and their shape selection, and (iii) design case study. Mechanical components have mass; they carry loads; they conduct heat and electricity; they are exposed to wear and to corrosive environments; they are made of one or more materials; they have shape; and they must be manufactured. This course provides knowledge on how these activities are related.

Course Objectives:

The goals of this course are 1) to develop advanced understanding on the basic concepts and methodology of materials selection in mechanical design; 2) to advance better understanding on mechanical properties (i.e., fracture, fatigue, creep, deep drawability, etc.) of different materials; 3) to make materials information readily available to designers during the design process; 4) to achieve or improve on a specified product performance or eliminate a material or service failure; and 5) to solve processing difficulties and/or take advantage of new processing techniques, reduce material and/or production costs and rationalize on materials stockholding, anticipate or exploit a change in the availability of a material.

Applicable ABET Outcomes:

1. An ability to apply knowledge of mathematics, science, and engineering
2. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
3. An ability to function on multi-disciplinary teams
4. An ability to identify, formulate, and solve engineering problems
5. An understanding of professional and ethical responsibility
6. An ability to communicate effectively
7. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Required Resources:

Textbook

1. Ashby, M. F. *Materials Selection in Mechanical Design*, 4th ed. Burlington: Elsevier, 2011. Print.
2. Gibson, L. J. and M. F. Ashby, *Cellular Solids: Structure and Properties*. 2nd ed., Cambridge: Cambridge University Press, 1997. Print.
3. Gibson, L. J. and M. F. Ashby, and B. A. Harley, *Cellular Materials in Nature and Medicine*. 2nd ed., Cambridge: Cambridge University Press, 2010. Print.

Useful supporting materials

1. Farag, M. M. *Materials and Process Selection for Engineering Design*, 3rd ed. Boca Raton: CRC Press, 2013, Print.
2. Ashby, M. F., Hugh Shercliff, and David Cebon. *Materials: Engineering, Science, Processing and Design*, 4th ed. Kidlington, Oxford, United Kingdom: Butterworth-Heinemann, 2019. Print.
3. Raman, A. *Materials Selection and Applications in Mechanical Engineering*. New York: Industrial Press, 2007. Print.
4. Dieter, G. E. *Mechanical Metallurgy*, 3rd ed. New York: McGraw-Hill, 1986. Print.
5. Meyers, M. A., and Krishan Kumar Chawla. *Mechanical Metallurgy: Principles and Applications*. Englewood Cliffs, N.J: Prentice-Hall, 1984. Print.
6. Smith, W. F. *Structure and Properties of Engineering Alloys*, 2nd ed. New York: McGraw-Hill, 1993. Print.

Course Content (tentative):

Week	Date	Topics	Homework
1	9/3/26	Introduction to Materials Selection I	
2	9/10/26	Introduction to Materials Selection II	Assginment #1
3	9/17/26	Stiffness-Limited Design	
4	9/24/26	Strength-Limited Design	
5	10/1/26	Case Studies for Stiffness- and Strength- Limited Design	Assginment #2
6	10/8/26	Fracture-Limited Design	
7	10/15/26	Creep-Limited Desgin	
8	10/22/26	Fatigue-Limited Design	Assginment #3
9	10/29/26	Midterm Review	
10	11/5/26	Midterm Exam	Term Paper
11	11/12/26	Materials, Environment and Sustainability	
12	11/19/26	Engineering Cellular Solids	
13	11/26/26	Cellular Solids in Medicine	
14	12/3/26	Cellular Solids in Nature	
15	12/10/26	High Entropy Alloys	
16	12/17/26	Term Paper Presentation I	
17	12/24/26	Term Paper Presentation II	

Grading Policies:

Requirements	Corresponding Percentages
Assignments (3)	5%
Individual Presentation	10%
Mid-Term Exam	35%
Term Paper	20%
Term Paper Presentation	25%
Participation	5%

Grading Scale:

100% ≥ A ≥ 90%; 90% > A- ≥ 85%; 85% > B+ ≥ 80%; 80% > B ≥ 76%; 76% > B- ≥ 73%; 73% > C+ ≥ 70%; 70% > C ≥ 66%; 66% > C- ≥ 63%; 63% > D ≥ 60%; 60% > F.

Homework:

There will be about **THREE** homework assignments that will be submitted on Blackboard either as Word document or as pdf before the start of the class (1:50 pm) on the due day. If you are unable to attend a class, you may attach a note to your homework and submit it in advance. ***If homework is submitted late, you would lose 10% per day. You may receive no credit if homework is not submitted within a week from the due day.***

Individual Presentation:

Each student of the class needs to give a 5 min presentation that includes a 1-page handout during the semester. Handouts and slides need to be submitted to Blackboard ***before the start of the class (1:50 pm) on the due day*** as a zip or rar file. Timing, presentation, style, content, and handouts will be considered for the grade. The topic can be chosen by each student (first come first serve basis) and needs to be relevant to “Materials Selection” (from research internship, coop, work, or interesting other topic) or an accident that involved failing material. If an accident is chosen as topic, 1 slide needs to be about ethical implications.

Exams:

An equation sheet might be permitted (information about this will be given a week before the exam). The students need to be present during the exam. In case of an emergency (doctors notice), a make-up exam might be given. The only allowed things during the exams are pens, ruler, water, potentially calculator. Paper and the equation sheet will be provided.

A student found ***cheating, attempting to cheat***, having an ***unauthorized device/tool*** during the exam ***independent of the reason*** will receive a zero on the exam.

Term Paper:

A term paper on a certain type of engineering materials, should be completed by a group of students. The term paper will be submitted on Blackboard either as Word document or as pdf. The document needs to be submitted to Blackboard ***before the start of the class (1:50 pm) on the due day.***

Term Paper Presentation:

Each group needs to give a 15-min presentation in the last class. The slides need to be submitted to Blackboard the ***before the start of the class (1:50 pm) on the due day*** as a zip or rar file. Timing, presentation, style, and content will be considered for the grade.

Participation:

Participation through presence but also answering questions, asking questions, contributing to activities is very important to improve active learning for each student. Therefore, your participation will be graded during each lecture starting with the second week.

Term Paper Guidelines

1. Paper Structure

Your paper should include the following sections:

- **Title Page:** Include the title of your paper, your name, course name, and date.
- **Abstract:** A concise summary (150–200 words) of your paper's objectives, methods, and key findings.
- **Introduction:** Provide background information on your topic, its significance, and the research question(s) you aim to address.
- **Literature Review:** Summarize and critically analyze relevant studies, theories, and findings related to your topic.
- **Methods:** Describe the approach you used to investigate your topic (e.g., literature review, case studies, modeling).
- **Results and Discussion:** Present your findings and discuss their implications. Compare your results with existing research.
- **Conclusion:** Summarize your key findings, their significance, and potential future research directions.
- **References:** Cite all sources used in your paper in a consistent format (e.g., APA, IEEE).

2. Length and Formatting

- **Length:** 8–10 pages (excluding references and appendices)
- **Font:** Times New Roman, 12-point
- **Line Spacing:** 1.5 Lines-spaced
- **Margins:** 1 inch on all sides
- **Citations:** Use in-text citations and include a complete reference list.

3. Research and Sources

- Use at least 30 credible sources, including peer-reviewed journal articles, books, and reputable online resources.
- Avoid relying solely on non-academic websites or Wikipedia.

4. Originality and Plagiarism

- Your paper must be original and written in your own words.

- Properly cite all sources to avoid plagiarism.
- Submit your paper through a plagiarism detection tool if required.

5. Submission Deadline

- Submit your term paper *before the start of the class (8:15 am) on Thursday (12/10/2026), Week 15* via Blackboard.

6. Grading Criteria

Your paper will be evaluated based on the following criteria:

- **Content and Depth:** Thoroughness of research, clarity of arguments, and relevance to the course.
- **Organization and Structure:** Logical flow, coherence, and adherence to the required format.
- **Critical Analysis:** Ability to critically evaluate and synthesize information.
- **Writing Quality:** Grammar, clarity, and professionalism.
- **References:** Proper citation and use of credible sources.

7. Suggested Topics

- The role of cellular materials in natural load-bearing structures (e.g., bamboo, bone).
- Design and optimization of porous scaffolds for tissue engineering.
- Biomimicking cellular materials for lightweight engineering applications.
- The mechanics of trabecular bone and its implications for orthopedic implants.
- Comparative analysis of cellular materials in plants and animals.
- The use of metal foams in biomedical and industrial applications.

8. Additional Resources

- Course lecture notes and recommended textbooks.
- Online databases such as PubMed, ScienceDirect, and Google Scholar.
- Consult with the instructor for guidance on topic selection and research.