MECH 329
Materials for Mechanical Design

Contact Information

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Course website: Canvas

Class Format

Lectures:	Mon/Wed/Fri	11 - 12	MacLeod 202
Tutorials:	Tue	16 - 17	MacLeod 202

The class format will be three one-hour lectures each week and one one-hour tutorial session every week. These hours may be shifted to suit the needs of the course and timeline (e.g. tutorial may occur during the lecture time and vice-versa). Students will be expected to do some independent research of materials information in textbooks or online. Course material like the "formula sheet" will be posted on the course website prior to midterms and finals. Some of the content delivered in class is not included in the suggested textbooks, hence it is recommended to attend classes and tutorials in order to be successful in this course.

Assigned homework problems will be posted on the course website on a weekly basis, based on the course progression. Enrolled students will be able to download the assignment and upload their solutions on Canvas. These assignments will not be graded unless the student's final score requires adjustment. The regular and timely

completion of the assignments will help the students' success in the course. All the assignments will have a deadline, however late submission is accepted. After the deadline, the solution will be posted; hence late submission will receive less consideration.

Tutorial time will be used to present example problems, show video material and other additional course material, answer student questions about the course material, and work on assignments.

The course assessment is based on 2 midterms (20% score-weight each), to be scheduled at the beginning of the course, one final exam (50% s-w) and an essay (10% s-w). The essay will involve the investigation of a real case study and can be done in two ways: 1. Industrially relevant case-study, where the student is invited to contact a company (either local or remote, via email/phone/Skype) and gather information of a recent problem the company has faced that is of relevance for the course (i.e. involves materials and mechanical design); 2. Academic and/or Research & Development problem: the student is invited to gather information in literature and contact a research scientist/engineer or professor for suggestions/consultations. The essay can be completed by individual students or by a group of students (maximum 4). The final evaluation of the essay will be based on the student's ability to identify the problem and investigate possible solutions with critical thinking. A problem template for both cases will be posted at the beginning of the course.

Pre-requisites

MECH 224, MECH 260, APSC 278; It is also recommended to attend/have attended MECH 360.

Learning objectives

1. The student will be able to differentiate the main material families.
2. The student will develop knowledge of material physical properties, including mechanical, chemical (corrosion) and thermal; their relevance to mechanical engineering problems and the microstructural mechanisms from which they emerge.
3. The student will be able to analyze mechanical components to evaluate the relevant design and material selection criteria.
4. The student will be able to read material data sheets and selection charts and use them appropriately, including the formulation and development of relevant material selection indexes.
5. The student will be able to calculate basic mechanical components after selecting an appropriate material, including considerations such as fracture criteria (e.g. leak before break) and other advanced concepts such as creep and corrosion resistance.
6. The student will acquire basic knowledge of manufacturing techniques, such as welding, and general criteria for selection of welding processes.

7. The student will develop a fundamental understanding of basic composite materials design and how composite properties emerge from it.

Course Grading Scheme

Essay:	10%
Midterm 1:	20% (Closed book)
Midterm 2:	20% (Closed book)
Final Exam:	50% (Closed book)

A proper formula sheet will be provided during the examination.

Textbook

Suggested Text:

M.F. Ashby, D.R.H. Jones, "*Engineering Materials 1: An Introduction to Properties Applications and Design",* Butterworth Heinemann.
M.F. Ashby, *"Materials Selection in Mechanical Design",* Butterworth Heinemann.

Optional Integrative Text:

M.F. Ashby, D.R.H. Jones, "*Engineering Materials 2: An Introduction to Microstructures, Processing and Design",* Butterworth Heinemann.

Course schedule

Week	Topic
1	**Introduction to Materials; Stiffness;**
2	**MSMD: Light-stiff components; Atomic bonds and packing; Atomistic origin of stiffness**
3	**Failure strength; MSMD: Light-strong components; Micro-mechanisms of plastic flow;**
4	**Alloying and other strengthening mechanisms; Fracture toughness;**
5	**MSMD: tough components; Molecular mechanisms of Fast Fracture;**
6	**Fatigue Failure and Design (cracked and uncracked components);**
7	**Creep Deformation and Fracture; Micro mechanisms; Design;**
8	**Oxidation and corrosion; Design;**
9	**Thermal properties; MSMD; Case studies; Welding;**
10	**Price and availability of materials; Materials and Ecology;**
11-13	**Design of Hybrid materials;**

MSMD=Materials Selection in Mechanical Design

- The syllabus is indicative; it will be updated with more details at the beginning of the course.