Western Engineering

Western University
Faculty of Engineering
Mechatronic Systems Engineering Program

MSE 3301A – Materials Selection & Manufacturing Processes

Course Outline Fall/Winter 2025

COURSE DESCRIPTION: In this course, students will reinforce and expand upon the importance and use of material properties, what they are and how they interact. They will learn to apply a systematic approach to the selection and evaluation of materials, configurations, and manufacturing processes, and select optimal materials, form factors, and processes to satisfy functional requirements. Overall, this links materials to functional design process, and to the performance- and requirement-analysis techniques students have learned in other courses.

ACADEMIC CALENDAR:
https://www.westerncalendar.uwo.ca/Courses.cfm?CourseAcadCalendarID=MAIN_023638_1&Keywords=3301

Fundamentals of shaping and strengthening materials used in mechatronics components. Material selection based on the composite properties of an application. Smart material fabrication and application to modern mechatronic devices.

PREREQUISITES: MSE 2202A/B or Integrated Engineering 2297A/B.
Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you will be removed from this course and it will be deleted from your record.

ANTIREQUISITES: MME 3379A/B.

CEAB ACADEMIC UNITS: Engineering Science = 50%, Engineering Design = 50%

CONTACT HOURS:

LECTURE:	3 hours/week
LAB:	None
TUTORIAL:	None

RECOMMENDED TEXT: M.F. Ashby "Materials Selection in Mechanical Design." 5th or 6th Edition, Butterworth-Heinemann, ISBN: 9780081005996 (5th) 9780443160288 (6th) (***Suggested***).
s~$70 USD from Elsevier (https://shop.elsevier.com/books/materials-selection-in-mechanical-design/ashby/978-0-443-16028-8?country=CA).

The 4th edition of the text is freely available via the Western Library online, but is not necessarily complete: https://ebookcentral.proquest.com/lib/west/detail.action?pq-origsite=primo&docID=4952361

RECOMMENDED/ REQUIRED SOFTWARE: ANSYS Granta EduPack (available from Engineering Software, https://appsanywhere.eng.uwo.ca/)

GENERAL LEARNING OBJECTIVES (CEAB GRADUATE ATTRIBUTES)

Knowledge Base	D	Engineering Tools	D	Impact on Society	D
Problem Analysis	D	Individual & Teamwork	D	Ethics and Equity	
Investigation	D	Communication	D	Economics and Project Mgmt.	D
Design	D	Professionalism		Life-Long Learning	

Notation: x represents the content level code as defined by the CEAB. blank = not applicable; I = introduced (introductory); D = developed (intermediate) and A = applied (advanced).

Rating: I – The instructor will introduce the topic at the level required. It is not necessary for the student to have seen the material before. D – There may be a reminder or review, but the student is expected to have seen and been tested on the material before taking the course. A – It is expected that the student can apply the knowledge without prompting (e. g. no review).

COURSE MATERIALS: Lecture slide PDFs will be available after the lecture on OWL.

UNITS: SI

COURSE TOPICS AND SPECIFIC LEARNING OUTCOMES:

1. Review of the types of materials used in mechanical components.
2. Review of material properties and their measurements: static strength, toughness, stiffness, fatigue, creep, etc.
3. Failure mechanisms
4. Formal selection procedures based on mechanical properties
5. Multi-objective optimization, and trade-offs
6. Integration of shape and material in selection
7. Material processing and influence on selection through economic models
8. Overview of hybrid materials and their influence on selection
9. Environmental and sustainability considerations with materials
10. Use and application of materials selection software ANSYS GRANTA EduPack

The following table summarizes the course learning outcomes along with CEAB GAIs where the GAIs in bold indicate ones to be measured and reported annually.

Course Topics and Specific Learning Outcomes	**CEAB Graduate Attribute Indicators**
Understand clearly the different material properties useful for design	KB3
Analyze correlations and trade-offs between material properties	PA1, I3
Specify exact methods to measure these properties	KB3
Use standard reference sources to compare materials	PA1, ET1
Develop formal selection strategies using property limits and material indices	PA2

Integrate shape into material selection	KB4
Utilize material indices to generate diverse list of candidate solutions, and select the most promising materials for further analysis	D2, D3
Develop selection strategies for process selection using economic analysis	EPM1
Integrate considerations of sustainability and environmental impact into the selection process	IESE2, IESE3
Understand creation and use of hybrid materials	KB4, D2
Combine material, process, and shape information into a single selection methodology	D3
Use the ANSYS GRANTA EduPack software	ET2
Solve case studies using a combination of formal selection procedures and an understanding of generic engineering properties of materials	D3

EVALUATION:

Name	**% Worth**	**Assigned**	**Due Date**	**CEAB GAs ASSESSED**
Assignment #1	2%			
Assignment #2	2%			
Assignment #3	2%			
Quiz #1	10%			
Quiz #2	10%			
Quiz #3	10%			
Project Report **Designated Assessment*	8%			D2, D3
Project Presentation	6%			
Final Examination	50%			D2, D3, KB4, IESE2, IESE3, EPM1

Note that the dates listed above are **tentative** and may be adjusted if needed. Marks will be assigned on the basis of method of analysis and presentation, correctness of solution, clarity and neatness.

COURSE POLICIES:

General

- Dates and other evaluation details are tentative and may be changed by the instructor. Notification will be sent through OWL
- Quizzes and exams will cover material presented in the textbook, lecture, lecture notes, and assignments, *as well as application and extension of these topics to new situations*
- Attendance is strongly encouraged, and **bonus points are given for iClicker participation** for students present in lectures. Bonus marks are allocated based on the fraction of questions *answered* in the full semester (irrespective of correct or incorrect responses):
    - ***> 87%, +1.5% bonus to final grade***

- ***> 70%, +1% bonus***
- ***> 60%, +0.5% bonus***
- *(These may be adjusted slightly at the instructor's discretion)*
- *Due to the large number of questions throughout the term, there will not be any possibility for re-weighting, make-up credit, or other considerations based on missed classes, technical issues, etc.*

Quizzes

- **Quizzes are take-home and must be completed on OWL within a fixed availability period.** This period will generally be 72 hours, but this will be announced on OWL before the first quiz and updated if needed.
- **As quizzes are available for an extended period (72 hours), and so requests for academic consideration will not be granted**
- Quizzes will be timed, and must be completed within the allotted time once the quiz begins. This will vary between quizzes but is generally around one hour.
- Quizzes are taken individually, and are closed-book, closed-note, with no discussion or use of online resources allowed
- Quizzes are weighted equally
- If Quiz 1 or 2 is missed with consideration, the grade will be reweighted from those quizzes that were completed. If Quiz 3 is missed with consideration, the weight will be moved to the final exam. No make-up quizzes will be offered.
- If a quiz is missed without consideration, a mark of 0 will be assigned for that quiz
- Quiz solutions will be available on OWL after the due date, and discussed in class
- *If there is any suspicion that quiz integrity may be compromised, quizzes may switch to in-person for remainder of term*

Assignments

- **Assignments must be submitted electronically via Gradescope**
- **Assignments are due by 8:00 am** local time at Western
- While you are encouraged to discuss the assignments with other students, it is expected that all students fully understand all submitted work and be able to reproduce any steps therein individually
- **Assignment questions are graded pass/fail**, with reasonable effort (generally meaning problems are *fully* attempted, but up to the discretion of the TA or instruction) granted full credit.
- Specific feedback on assignment submissions will not be provided, however **solutions will be posted**
- Individual feedback may be requested during office hours

Project

- **Project consists of a short, (~ 5 page limit) report (8% of course grade) and presentation (~ 3 minutes, 6% of course grade)**
- **Projects are done in groups of 3 students**
- Presentations will be given in class the week before reading week (Oct. 28, 30).
- Details of the project requirements will be discussed during lecture and posted to OWL in advance

Final examination

- Final exam will be *closed book, closed note, but the full equation sheet on the course website will be provided on the exam*.

- Non-programmable calculators may be used. Computers, smartphones, tablets, etc. are not allowed
- Students must notify the instructor if they require accommodations or special considerations for the final exam
- If a minimum mark of 50% is not obtained on the final exam the student cannot receive a final course mark greater than 48%. Students arriving more than 30 minutes late for an in-person exam will not be allowed to write the exam and will receive zero marks.

LATE SUBMISSION POLICY:

Advise the instructor if you are having problems completing the assignment on time prior to the due date of the assignment and be prepared to submit an Academic Consideration Request and provide documentation if requested by the instructor at:
https://www.eng.uwo.ca/undergraduate/academic-consideration-for-absences.html
If you are granted an extension, establish a due date with the instructor. The approval of the Chair of your Department is not required if assignments are completed prior to the last day of classes. Extensions beyond the end of classes must have the consent of the instructor, the department Chair and the Associate Dean, Undergraduate Studies.
Documentation is mandatory.

This course employs flexible deadlines for assignments. The assignment deadlines can be found above in the course outline. For each assignment, students are expected to submit the assignment by the deadline listed. Should illness or extenuating circumstances arise, students are permitted to submit their assignment up to 48 hours past the deadline without academic penalty. Should students submit their assessment beyond 48 hours past the deadline, credit will not be given, as solutions will be posted. **As flexible deadlines are used in this course, requests for academic consideration will not be granted.** If you have a long-term academic consideration or an accommodation for disability that allows greater flexibility than provided here, please reach out to your instructor at least one week prior to the posted deadline.

FACULTY OF ENGINEERING POLICIES:

Students must familiarize themselves with the policies of the Faculty of Engineering