

MATLS 4MS4/6MS4 – MATERIALS SELECTION IN DESIGN AND MANUFACTURING

Fall 2021 Course Outline

Instructor: Dr. J. McDermid
Office: JHE-343C/A
e-mail: mcdermid@mcmaster.ca
Office hours: During tutorial period and by appointment via Teams

Lectures: Tuesday and Friday 08:30 – 10:20 (ETB 235). Lectures will be in-person for as long as is consistent with Public Health guidelines and McMaster University policy decisions. If in-person lectures are no longer permitted, lectures will be livestreamed via MS Teams. Lectures will be held for the first ten weeks of classes (approximately). Lecture attendance is strongly encouraged as we will be running through numerous examples and case studies which are directly applicable to the assignments and course projects.

Tutorials: Monday (T01) 16:30-17:20 (BSB B156); Tuesday (T02) 12:30 – 13:20 (JHE 329). Tutorials will start on Monday September 13th and will continue through the term. Tutorials will be held in-person as long as this is consistent with Public Health guidelines and McMaster University policy. If this delivery method is no longer possible, tutorials will be held via MS Teams.

Tutorials constitute an important part of the course and provide students the opportunity for direct consultation with Dr. McDermid and the TAs on assignments and term projects. Switching of tutorial sections will not be permitted.

Learning Outcomes

By the end of this course, the student should be able to:

1. Derive materials indices associated with specified design objectives or constraints, be they mechanical, thermal, cost, environmental or any combination thereof;
2. Employ their derived materials indices and the Granta EduPack software to select the optimum material(s) to meet their design requirements or constraints;
3. Employ their selected materials in designs of their own conception which fulfil the design objectives;
4. Assess the environmental impact of materials selection choices within the context of intended materials use, including the choice of the appropriate materials index;
5. Effectively communicate the details of their designs – including justification for a given materials selection – through written reports and technical drawings, as appropriate.

Graduate Attributes:

MATLS 4MS4 provides the undergraduate student the opportunity to develop competence in the following CEAB graduate attributes:

Graduate Attributes	Learning Outcome Measurement Point
1.4 – Competence in Specialized Engineering Knowledge	3
3.2 – Selects appropriate model and methods and identifies assumptions and constraints	1, 3
4.1 – Recognizes and follows an engineering design process	3
4.3 – Proposes solutions to open-ended problems	3
5.2 – Demonstrates ability to use modern/state of the art tools	2
7.3 – Constructs effective oral or written arguments as appropriate to the circumstances	5
9.3 – Assesses possible options and design configurations from a sustainability engineering perspective, which emphasizes environmental stewardship, life-cycle analysis, and long-term decision-making principles	4

Teaching Assistants:

Name	Office	E-mail	Role
Sara Filice	JHE A203C	filicese@mcmaster.ca	Lead TA, project marking, tutorials
Mahmoud Diab	JHE A206A	diabmm@mcmaster.ca	Project marking, tutorials
Youssef Salib	JHE A206A	saliby@mcmaster.ca	Assignment marking

TA office hours will be determined via a straw poll conducted in class to facilitate student access. It is strongly suggested that students contact the TAs during scheduled office hours or during tutorials. Appointments outside of office hours should be arranged using the e-mails provided above.

Course Website: MATLS 4MS4/6MS4 has an Avenue to Learn (A2L) site which students can access via their MacID and password. The MATLS 4MS4/6MS4 A2L site is an critical means of communication between Dr. McDermid and the class and should be consulted regularly. Course announcements, project and assignment information (including due dates), abridged lecture notes, recorded lectures, assignment and project solutions and tutorial information can be accessed through the MATLS 4MS4/6MS4 A2L site. Students are reminded that they are solely responsible for keeping up-to-date with all course announcements, instructional materials and due dates, including postings on the course A2L site. Students should inform Dr. McDermid if they encounter problems with the course A2L site.

Important Dates: The following are draft due dates for major coursework components with the addition of final project proposals and final project due dates for MATLS 6MS4 students only. Students should note that the below due dates are subject to alteration depending on the delivery of lecture materials and other factors. It is the student’s responsibility to be aware of any

alterations in the due dates for coursework via in-class announcements or the MATLS 4MS4/6MS4 A2L site.

Item	Date
Mid-term #1 – Materials Selection in Mechanical Design	Friday October 8, 2021
Project #1 – report due	Friday October 22, 2021
Mid-term #2 – Materials Selection in Thermo-mechanical Design	Friday November 12, 2021
Project #2 – report due	Friday November 19, 2021
MATLS 6MS4 – Project Proposal	Friday November 5, 2020
MATLS 6MS4 – Final Project Due	Friday December 10, 2021

Texts: There is one course text and several supplementary texts (from previous courses taken at McMaster) which will be helpful to consult in the solution of assignment problems and projects.

Course text: “Materials Selection in Mechanical Design, 5th Edition” by M.F. Ashby, Butterworth-Heinemann (2016). The textbook is available in the bookstore, with many used textbooks available. E-books are also available. The textbook is not required, but useful equations, examples and other resources are available in the text which students may find helpful for course assignments and projects.

Supplemental: “Mechanics of Materials, 5th Edition” by F.P Beer *et. al.*. This textbook should be consulted for a review of introductory solid mechanics.

“Fundamentals of Heat and Mass Transfer, 6th Edition” by Incropera *et al.*. This textbook should be consulted for a review of fluid flow and steady-state and transient heat transfer.

Software: All students are required to download and install a free copy of the Granta EduPack 2021 software, the software installation instructions of which are posted on the course A2L site. The software is a required tool for students in selecting their optimal materials for the assigned problem sets and projects. Unfortunately, an Apple iOS or Linux-compatible version of the Granta EduPack software does not exist and students running Apple iOS or Linux can run Granta EduPack under a Windows partition or can access the software remotely via the MSE computer cluster. Access to the computer cluster is limited and, therefore, will only be permitted by permission from Dr McDermid. The use of earlier versions of EduPack is strongly discouraged as the database is expanded every year and may not yield the same materials choices for a given materials index as the current version. Students are advised that they use earlier versions of EduPack at their own risk.

Overview of Course Lecture Modules:

- Introduction to Materials Property Charts and Derivation of Materials Indices
- Materials Selection and Design based on Mechanical and/or Environmental design constraints

- Materials Selection and Design based on Thermo-mechanical, Environmental and mixed design constraints
- Design of Sandwich Hybrid Materials
- Environmentally based Materials Selection (i.e. Eco-Selection), including rudimentary life-cycle assessment using the EduPack Eco-Audit Tool

The course material will be delivered via lecture modules, for which *.pdf versions will be posted on the A2L site. The lecture materials will largely consist of in-class examples and case studies. The vast majority of in-class exercises will employ the Granta EduPack software to select the optimal material based on a derived materials index or indices. In-class examples are designed to prepare students for course assignments, projects and mid-terms; it is strongly recommended that students attend the course lectures to take advantage of these examples.

Tutorials will consist of several elements: (i) the basics of using the Granta EduPack software, which will be conducted in the first tutorial sessions, (ii) a workshop on the writing of MATLS 4MS4/6MS4 design reports, (iii) consultation on assignment problems and general assistance with course material and (iv) project consultation. Dr. McDermid will attend the vast majority of the tutorials.

Course Assessment and Details of Course Elements

The following mark distribution will be used for MATLS 4MS4:

Assignments:	20% (composite of all assignment marks)
Mid-terms:	2 × 10% each (20% total)
Project #1:	25%
Project #2:	35%

The following mark distribution will be used for MATLS 6MS4:

Assignments:	15% (composite of all assignment marks)
On-Line Quizzes:	2 × 10% each
Project #1:	15%
Project #2:	25%
Final Project:	25%

Unless otherwise noted, all assignments and projects are due by 17:30 on the designated due date and are to be submitted to the course dropbox in JHE with the assignment/project EduPack files submitted to the appropriate assignment/project folder in A2L. Neat, legible, hand-written assignment solutions and project calculations are acceptable and encouraged. The body of project reports should be word processed per the descriptions provided below.

Lectures

MATLS 4MS4/6MS4 Lectures will comprise a mixed media forum using a combination of PowerPoint-based lecture notes and the solution of design problems using a chalkboard/whiteboard. If forced to go to a virtual format, lectures will utilize MS Teams and a

virtual whiteboard technology (a LightBoard) for the lecture slides and the working of problems/case studies. The majority of the lectures will be devoted to the definition and solution of a series of increasingly complex mechanical and thermo-mechanical materials selection/design problems.

Assignments

Four problem sets are planned for the term and will consist of questions concerning optimal materials selection and design of specific objects with defined design constraints. Assignments and due dates will be announced in class and posted on the course A2L site. The primary objective of the assignments is to prepare students for the class projects and mid-terms. Solutions to assignment problems will be posted on A2L approximately one week after the assignment due date. Students must submit individual, independently written assignment solutions in proper engineering format, consisting of the required and given, any equations used in the solution of the problem and properly formatted drawings, plots and tables, as required. Neat, hand-written solutions are perfectly acceptable and encouraged. Assignments should be submitted with a title page which includes the student name, student number, course identification and assignment number to the assigned physical drop box. Students must submit all Granta EduPack files used in the solution of assignment problems to the appropriate A2L assignment folder. Files can be zipped or uploaded to A2L individually and should be named appropriately to facilitate marking by the TAs.

Mid-Terms

There will be two mid-terms to be held during a regularly scheduled lecture period which will assess the student's ability to derive materials indices, select the optimal material(s) for a defined design objective and/or constraint and to develop a rudimentary design using their selected material. Draft dates for the mid-terms are provided in the "Important Dates" section of the course outline and the final dates will be announced during the lectures and posted on the A2L site. The Granta EduPack software will not be used in the mid-terms. Candidate materials with appropriate properties will be provided as part of the mid-term.

Projects #1 and #2

Two term projects will be assigned which will consist of a problem in materials selection in mechanical design with multiple constraints (project #1) and a more advanced problem in materials selection in thermo-mechanical design with multiple constraints (project #2). Project #2 designs are usually based on real-world engineering problems/objects drawn from Dr. McDermid's industrial background. Individual reports will be submitted for projects #1 and #2. Project reports must conform to the guidelines specified in the document "*Project Report Writing Guidelines*" posted on the course A2L site. Granta EduPack files used in the project solution must be submitted to the appropriate project A2L assignment box.

MATLS 4MS4/6MS4 Final Project – Proposal, Selection and Report

A final project consisting of a multi-faceted materials selection and design problem will be due at the end of the semester for students enrolled in MATLS 6MS4. MATLS 6MS4 final project

reports will present a solution to the approved design problem and will include economic evaluation criteria. All final project reports will be marked by Dr. McDermid.

MATLS 6MS4 students will submit a project proposal to be approved by Dr. McDermid *via* the project proposal form available on the course A2L site. Students are encouraged to select a final project which can have positive impact on or contribute to their graduate studies project. Discussions with Dr. McDermid concerning the project proposal and its approval/modification will be completed as quickly as possible following submission of the project proposal. The final project report will comprise a properly formatted engineering report per the guidelines contained in the document “*Project Report Writing Guidelines*” on the course A2L site. Each student must submit the Granta EduPack files used in their project to the final project A2L drop box.

Final Examinations

There is no final examination.

Policy Statement on the Late Submission of Coursework

All coursework must be submitted on time or deductions will be made without valid and documented reasons. All late coursework must be submitted to Dr. McDermid or the MSE office (for date and time stamping) and will be assessed for a late penalty at the discretion of Dr. McDermid. Late course work will not be accepted by the TAs under any circumstances. In general, the following penalties will apply:

- Assignments: a deduction of 25% per day to a minimum of zero credit. Late assignments will not be accepted after the solutions have been posted on A2L.
- Projects: a deduction of 50% per day to a minimum of zero credit. Projects will not be accepted after the project solutions have posted on A2L.

Policy Statement on Requests for Relief for Missed Academic Term Work

McMaster Student Absence Form (MSAF): In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar “Requests for Relief for Missed Academic Term Work”.

Use of the MSAF will automatically result in the following accommodations:

- Assignments and Projects: the accommodation for all assignments and projects will be a 48 hour deferred due date after the submission of the MSAF. The deferred assignment will be due to the appropriate A2L Assignment folder by 17:30 of the revised due date. If the deferred due date falls on a Saturday, Sunday or Statutory Holiday, the coursework will be due to the appropriate A2L Assignment folder at 09:00 on the next working day. If the solutions for the assignment or project have been posted on the website or discussed in the tutorial, an alternative assignment or project will be assigned to the student.
- Mid-terms: a make-up mid-term will be held at an assigned time for all students who missed the on-line quiz.

Appeal of Marks:

All queries or appeals of marks received on course work should first be directed at the TA who marked the work – it is his or her responsibility to clarify deductions and remedy any errors. If, however, the student continues to feel that they received an unfair or erroneous deduction after discussing their case with the TA, students can submit their course work to Dr. McDermid for re-marking. Students should note that re-marking by Dr. McDermid may result in a lower mark being assigned than was originally received from the TA.

McMaster University Policy Statements

Academic Integrity

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. **It is your responsibility to understand what constitutes academic dishonesty.** Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: “Grade of F assigned for academic dishonesty”), and/or suspension or expulsion from the university. For information on the various types of academic dishonesty please refer to the [Academic Integrity Policy](https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/), located at <https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/>

The following illustrates only three forms of academic dishonesty:

- plagiarism, e.g. the submission of work that is not one’s own or for which other credit has been obtained.
- improper collaboration in group work.
- copying or using unauthorized aids in tests and examinations.

Authenticity/Plagiarism Detection

Some courses may use a web-based service (e.g. Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. A2L, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. **All submitted work is subject to normal verification that standards of academic integrity have been upheld** (e.g., on-line search, other software, etc.). For more details about McMaster’s use of Turnitin.com please go to www.mcmaster.ca/academicintegrity.

Courses with an On-Line Elements

Some courses may use on-line elements (e.g. e-mail, Avenue to Learn (A2L), LearnLink, web pages, capa, Moodle, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses on-line elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure please discuss this with the course instructor.

On-Line Proctoring

Some courses may use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/ software during tests or exams. This software may be required to be installed before the test/exam begins.

Conduct Expectations

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities. These expectations are described in the [Code of Student Rights & Responsibilities](#) (the “Code”). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, **whether in person or online**.

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students’ access to these platforms.

Academic Accommodation of Students with Disabilities

Students with disabilities who require academic accommodation must contact [Student Accessibility Services](#) (SAS) at 905-525-9140 ext. 28652 or sas.mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University’s [Academic Accommodation of Students with Disabilities](#) policy.

Academic Accommodation for Religious, Indigenous or Spiritual Observances (RISO)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the [RISO](#) policy. Students should submit their request to their Faculty Office **normally within 10 working days** of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

Copyright and Recording

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, **including lectures** by University instructors.

The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

Extreme Circumstances

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.

revised August 2021 by Dr. J. McDermid