

MECH ENG 746
Mechanical Behavior of Polymer Composite Materials
Graduate Studies
Fall 2026
Course Outline

CALENDAR/COURSE DESCRIPTION

The course covers topics intended to introduce various aspects of composite materials. Design and mechanical behaviour of composite materials will be introduced. Topics will include reinforcement and matrix materials, manufacturing methods, composite applications, analysis of composite systems using micromechanics, orthotropic lamina theory, macromechanics and failure analysis of laminates.

PRE-REQUISITES AND ANTI-REQUISITES

Prerequisite(s): None
Antirequisite(s): None

INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION

Dr. Duncan Cree
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Office Hours:
By appointment

TEACHING ASSISTANT OFFICE HOURS AND CONTACT INFORMATION

TBD

COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION

Course notes, assignments, solutions, general course information, and announcements will be posted on Avenue to Learn (A2L), the course website. Students are responsible for keeping up to date with the information on Avenue to Learn via the following link: <http://avenue.mcmaster.ca/>. The course will be delivered in-person; all the lectures, tutorials and exams will be in-person.

COURSE INTENDED LEARNING OUTCOMES

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

- Explain the properties of fiber and matrix materials used in composites, their applications, safety, recycling and some common manufacturing techniques.
- Analyze stress and strain analysis of orthotropic materials having continuous fiber reinforcements at the lamina and laminate level.
- Compare failure theories to determine composite failure stresses.
- Review the literature, write a report on a composite manufacturing process and conduct a presentation of their findings.

MATERIALS AND FEES

Required Text: Not mandatory

Stress Analysis of Fiber Reinforced Composite Materials, M. W. Hyer and S. R White, Destech publications, 2009.

Recommended Additional Texts:

- 1) Composite Materials: Science and Engineering, Krishan k. Chawla, 3rd Edition, Springer 2012
- 2) Mechanics of Composite Materials, Autar K. Kaw, 2nd Edition, CRC-LLC Press, 2005.
- 3) Mechanics of Composite Materials, R. M. Jones, 2nd Edition, Taylor & Francis, 1999.
- 4) Engineering Mechanics of Composite Materials, Daniel and Ishai, 2nd Edition, Oxford University Press, 2005.
- 5) Introduction to Composite Materials Design, Ever J. Barbero, 2nd Edition, Taylor & Francis, 2011.
- 6) An Introduction to Composite Materials, D. Hull & T.W. Clyne, 2nd Edition, Cambridge University Press, 1996.

Calculator:

Only the McMaster Standard Calculator will be permitted in tests and examinations. This is available at the Campus Store.

Other Materials: None

COURSE FORMAT AND EXPECTATIONS

The course is organized as follows:

- 2 classroom-based lectures per week
- 9 assignments
- Report and presentation
- 1 in-class midterm test
- 1 in-class final exam

COURSE SCHEDULE

Week	Lecture	Topic	Readings
1	1	Introduction to Composites	Various Sources
2	2, 3	Properties of Composite Constituents/Applications	Various Sources
3	4, 5	Manufacturing Methods/Recycling/Health& Safety/Micromechanics of a Lamina	Various Sources, 2
4	6	Orthotropic Material	2
5	7	Micromechanical Analysis of a Lamina/Plane Stress Assumption	2, 4
6	No lectures	Reading Week	
7	8,9	Local and Global Coordinate System	5
8	No lectures	Midterm exam	
9	10, 11	Macromechanical Analysis of Laminates	6
10	12	Force and Moment Resultants	7
11	13,14	Laminate Stiffness Matrix (ABD matrix)	7
12	15	Failure Theory	9, 10
13		Graduate Student Presentations	
		Final Exam-3 Hours (location: TBD)	

ASSESSMENT

Component	Due Date	Weight
Assignments	TBA	10%
Report/Presentation	(Week 13)	15%
Midterm Exam	(Week 8)	25%
Final Exam	TBA	50%
Total		100%

Assignments: There will be nine assignments throughout the semester. The assignments will be available on the course website/Avenue-to-Learn and students will be made aware of their due date. The students should know that some of the assignments will require extensive work.

Report/ Presentation: Students will select a topic related to this course (with approval by the instructor) and will prepare a report and a PowerPoint presentation giving an overview of the subject, major advantages/disadvantages, applications, etc. Towards the end of the term, time will be set aside for each presentation to be made to the rest of the class. Each talk will be followed by a question period. Each student will submit a report. Marks will be awarded for:

- Presentation style (audibility, structure, clarity, quality of visual aids etc.).
- Report technical content (showing understanding of subject, grasp of key points, explanation, etc.).
- A report outline/presentation requirements will be available on Avenue-to-Learn.

ACCREDITATION LEARNING OUTCOMES

The Learning Outcomes defined in this section are measured for Accreditation purposes only and will not be directly taken into consideration in determining a student's grade in the course.

Outcomes	Indicators
1. Explain the properties of fiber and matrix materials used in composites, their applications, safety, recycling and some common manufacturing techniques.	A knowledge base for engineering
2. Analyze stress and strain analysis of orthotropic materials having continuous fiber reinforcements at the lamina and laminate level.	A knowledge base for engineering, problem analysis
3. Compare failure theories to determine composite failure stresses.	Design, Use of engineering tools
4. Review the literature, write a report on a composite manufacturing process and conduct a presentation of their findings.	Communication skills

For more information on Accreditation, please visit: <https://www.engineerscanada.ca>

EQUITY, DIVERSITY, AND INCLUSION

Every registered student belongs in this course. Diversity of backgrounds and experiences is expected and welcome. You can expect your instructor to be respectful of this diversity in all aspects of the course, and the same is expected of you.

McMaster University is committed to creating an environment in which students of all genders, cultures, ethnicities, races, sexual orientations, abilities, and socioeconomic backgrounds have equal access to education and are welcomed and treated fairly. If you have any concerns regarding inclusion in our department, in particular if you or one of your peers is experiencing harassment or discrimination, you are encouraged to contact the Chair, Associate Chair (Undergraduate), Academic Advisor or the [Equity and Inclusion Office](#).

MENTAL HEALTH & WELLNESS

For a list of McMaster University's resources, please refer to the [Student Wellness Centre](#). [Talkspot](#) is a non-crisis mental health resource specifically for students in the Faculty of Engineering.

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](#), located at <https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/>

The following illustrates only three forms of academic dishonesty:

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

ARTIFICIAL INTELLIGENCE TEXT GENERATOR TOOLS

Artificial intelligence text generator tools (also known as large language models) are not permitted to be used in any assessments for this course. Any use of such tools will be considered academic misconduct in this course.

AUTHENTICITY / PLAGIARISM DETECTION

Some courses may use a web-based service (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 ELEMENT

McMaster is committed to sustaining an inclusive and respectful community. These principles and expectations extend to online activities including electronic chat groups, video calls and other learning platforms.

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.

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.

COURSE POLICY ON MISSED WORK, EXTENSIONS, AND LATE PENALTIES

1. It is the students’ responsibility to regularly check the course webpage (ex. Avenue to Learn) for updates and announcements.
2. The weight of any missed work that has been properly reported and approved using MSAF will be automatically added to the weight of the final examination. No other accommodation will be provided for missed work.

SUBMISSION OF REQUEST FOR RELIEF FOR MISSED ACADEMIC WORK

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”.

1. **Relief for missed academic work worth less than 25% of the final grade resulting from medical or personal situations lasting up to three calendar days:**
 - Use the [McMaster Student Absence Form](#) (MSAF) on-line self-reporting tool. No further documentation is required.
 - Students may submit requests for relief using the MSAF once per term.

- An automated email will be sent to the course instructor, who will determine the appropriate relief. Students must immediately follow up with their instructors. Failure to do so may negate the opportunity for relief.
 - The MSAF cannot be used to meet a religious obligation or to celebrate an important religious holiday.
 - The MSAF cannot be used for academic work that has already been completed attempted.
 - An MSAF applies only to work that is due within the period for which the MSAF applies, i.e. the 3-day period that is specified in the MSAF; however, all work due in that period can be covered by one MSAF.
 - The MSAF cannot be used to apply for relief for any final examination or its equivalent. See *Petitions for Special Consideration* above.
2. **For medical or personal situations lasting more than three calendar days, and/or for missed academic work worth 25% or more of the final grade, and/or for any request for relief in a term where the MSAF has been used previously in that term:**
- Students must report to their Faculty Office to discuss their situation and will be required to provide appropriate **supporting documentation**.
 - If warranted, the Faculty Office will approve the absence, and the instructor will determine appropriate relief.

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.