

**Western University**  
**Department of Mechanical & Materials Engineering**  
**MME4480A – Advanced CAE: Reverse Engineering**

**COURSE OUTLINE 2024-2025**

**CALENDAR DESCRIPTION**

This course is an introduction to the use of modern computer-aided design (CAD) techniques in generation of 3D digital models from physical objects. Topics include contact and non-contact data acquisition techniques, data type and exchange formats, and advanced visualization and surfacing techniques.

**COURSE INFORMATION**

Instructor: Ben Hamilton, PhD  
Office: SEB 2057A  
e-mail: ben.hamilton@uwo.ca

Lectures/Labs: See [Draft My Schedule](#)

Consultations: By appointment

**PREREQUISITES** MME 2259A/B or MSE 2202A/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. This decision may not be appealed. You will receive no adjustment to your fees if you are dropped from a course for failing to have the necessary prerequisites.

**ACCREDITATION UNITS**

Engineering Science = 70%, Engineering Design = 30%

**TOPICS**

1. Introduction to reverse engineering of physical objects
  - historical notes on reverse engineering (RE)
  - overview of RE process
2. Data acquisition techniques
  - classification of RE techniques
  - noncontact techniques: laser scanning, CT/MRI
  - contact techniques: coordinate measurement machine (CMM)
  - destructive techniques
  - case studies involving RE
3. Data types and data exchange formats
  - nonparametric data formats: cloud of points, polygonal mesh
  - parametric data format (B-Rep/NURBS)
  - polygonal vs. parametric data
  - data exchange operations
  - mitigation of data exchange errors
4. Parametric data reconstruction
  - nonparametric to parametric data conversion
  - computer graphics and graphical output of CAD
  - modeling strategies: history-based and direct
  - manifold and non-manifold models
  - surfacing operations and functionality
  - surface quality analysis; class A surfaces
  - industrial applications of class A surface
  - accuracy of parametric data reconstruction

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5. Additive manufacturing
  - review of additive manufacturing technologies
  - materials
  - model preparation
  - printing scanned models

### **LEARNING OUTCOMES**

The Mechanical and Materials Engineering Program has been accredited by Canadian Engineering Accreditation Board (CEAB) of Engineers Canada. Accredited programs provide the academic requirements for licensure as a professional engineer in Canada. Western Engineering has defined indicators of the 12 Graduate Attributes (GAs) that the CEAB expects graduating engineering students to demonstrate. The connections between course learning outcomes and [Western Engineering's GA Indicators](#) are identified below.

Upon the successful completion of the course, students will:

- Understand the principles underlying data acquisition in the context of reverse engineering of physical objects. (KB3, ET2, ET3)
- Compare and exploit the capabilities of different data acquisition techniques to generate digital models of physical objects. (D3, D4, LL2)
- Understand the structural differences between the different types of CAD data formats. (KB4, ET1, ET2)
- Select and use the appropriate format for a CAD data exchange operation. (ET1, ET2, LL2)
- Understand the theoretical basis of internal CAD representations. (KB1, KB4)
- Develop strategies and skills for manipulation and modeling for freeform/complex/sculptured surfaces. (ET1, ET2)
- Select and implement additive manufacturing processes to 3D scanned models. (ET2, D3, D4)

### **CONTACT HOURS**

3 lecture hours, 2 laboratory/tutorial hours per week, half course

### **COURSE TEXTBOOKS**

References will be provided during lectures.

### **EVALUATION**

The course grade will be determined as follows:

Four assignments	14%	Sep 26, Oct 24, Nov 14, Dec 5
CSWPA-SU test	14%	Nov 13
CSWA-AM test	8%	Dec 4
Mid-term examination	14%	Nov 6
Final examination	50%	During examination period

Note: If deadlines for assignments are not met, a two-day grace period will be allowed without penalty. A delay of more than two days will result in a mark of zero. Please note that because the submission deadline for these assignments already includes flexibility in the form of a 48-hour submission window, the instructor reserves the right to deny academic consideration for assignments which are submitted following the end of the period of flexibility.

### **COMPUTER SOFTWARE**

Student version of SolidWorks 2024 program will be available on all lab computers and for installation on students' computers.

### **COURSE POLICIES**

If a student misses the midterm exam with consideration, the weight of the midterm exam will be applied to the final exam. If a student misses the midterm exam without consideration, the midterm exam's mark will be zero. Please note that this assessment is considered to be central to the learning objectives for this course. Accordingly, students seeking academic consideration for this assessment will be required to provide formal supporting documentation.

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If technical issues prevent a student from successfully completing and submitting the midterm examination, at the instructor's discretion the weight of the examination may be shifted to the final exam. No make-up midterm examination will be offered in this case.

If technical issues prevent a student from successfully completing and submitting the final examination, the official guidelines from the Associate Dean's Office, Undergraduate Affairs will be followed. Options to be considered will include, but without being limited to, an oral examination or a make-up examination in the special examination period.

If there is legitimate cause for suspicion of cheating during tests, the midterm exam or final exam exists, the student will be required to participate in a one-on-one oral examination with the instructor. The mark obtained in the oral examination will supersede the one obtained during the written quiz. If the student refuses his/her participation in the oral examination, the examination will be automatically graded with zero and further academic penalties for scholastic offences will be applied.

Students are required to contact the instructor of the course for any other circumstances that appear to not be covered by the non-exhaustive list above.

### **CLASSROOM DEMEANOR**

The instructor is committed to providing a respectful learning environment for all students involved in this course. This is a collective responsibility of the instructor and students, and therefore students partaking in this course agree to abide by this criterion. This includes arriving at lectures on time and acting in a professional manner during class.

### **GENERAL FACULTY / UNIVERSITY POLICIES**

In the event of contradictions between course-specific policies above and general Faculty / University policies described below, please contact your course instructor for clarification.

- |   |   |
|---|---|
| <b>Attendance</b>                       | Any student who, in the opinion of the instructor, is absent too frequently from class or laboratory periods in any course, will be reported to the Associate Dean Academic (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Associate Dean Academic, the student will be debarred from taking the regular examination in the course.  |
| <b>Missed/Late Accommodation Policy</b> | <ol style="list-style-type: none"><li>1. Students missing a test/assignment/lab or examination you will report the absence by submitting an Academic Consideration Request form through <a href="#">STUDENT ABSENCE PORTAL</a>.</li><li>2. <b>Documentation must be provided as soon as possible.</b></li></ol>   |
| <b>Exam Accommodation</b>               | <ol style="list-style-type: none"><li>1. If you are unable to write a final examination, report your absence using the Academic Consideration Request Form through <a href="#">STUDENT ABSENCE PORTAL</a>.</li><li>2. Be prepared to provide the Undergraduate Services Office with supporting documentation (below for information on documentation) the next day, or as soon as possible (in cases where students are hospitalized). The following circumstances are not considered grounds for missing a final examination or requesting special examinations: common cold, headache, sleeping in, misreading timetable and travel arrangements.</li><li>3. In order to receive permission to write a Special Examination, you must obtain the approval of the Chair of the Department and the Associate Dean and in order to apply you must submit an Academic Consideration Request Form through <a href="#">STUDENT ABSENCE PORTAL</a>.</li></ol> |

*PLEASE NOTE: It is the student's responsibility to check the date, time and location of the Special Examination.*

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**Late Assignments**

1. Advise the instructor if you are having problems completing the assignment on time (prior to the due date of the assignment).
2. Be prepared to submit the Academic Consideration Request Form and provide documentation if requested by the instructor (see below for information on documentation).
3. If you are granted an extension, establish a due date. The approval of the Chair of your Department (or the Assistant Dean, First Year Studies, if you are in first year) is not required if assignments will be completed prior to the last day of classes.
4. Some courses may have built-in flexibility for assignment deadlines or the total number of assignments that will be graded. See course-specific policies for details.
5. 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.

*Note: Forged notes and certificates will be dealt with severely. To submit a forged document is a scholastic offence (see below).*

**Medical  
Accommodation**

1. The Academic Consideration Request Form is available through the [STUDENT ABSENCE PORTAL](#).
2. Requests for academic consideration must include the following components:
  - a. Indication of the course(s) and assessment(s) affected by the request
  - b. Medical note, and
  - c. Additional supporting documentation as relevant
3. Requests for academic consideration without a medical note or other supporting documentation may be accepted once per term, per course.
4. Undocumented absences cannot be used for examinations scheduled by the Office of the Registrar during official examination periods (including take-home final exams and December mid-year exams for full courses) and practical laboratory and performance tests typically scheduled in the last week of the term. Undocumented absences also cannot be used for the “designated assessment” in each course. When flexibility in assessment exists and is clearly stated on the course outline, both undocumented absences and academic consideration requests with documentation may be denied.
5. **Students must request academic consideration as soon as possible and no later than 48 hours after the missed assessment.**
6. Once the request and supporting documents have been received and reviewed, appropriate academic consideration, if granted, shall be determined by the instructor in consultation with the academic advisor, in a manner consistent with the course outline.

Academic consideration may include extension of deadlines, waiver of attendance requirements for classes/labs/tutorials, or re-weighting of course requirements. Some forms of academic consideration, such as arranging Special Examinations, assigning a grade of Incomplete, or granting late withdrawals without academic penalty, may only be granted by the Academic Advising office of the Faculty of Registration.

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7. An instructor may deny academic consideration for any assessment that is not required in the calculation of the final grade (e.g., “8 of 10 quizzes”). Assessment flexibility must be indicated on the course outline.
8. An instructor may deny academic consideration relating to the timeframe submission of work where there is already flexibility in the submission timeframe (e.g., 72-hour submission window). This assessment flexibility must be indicated on the course outline.

**Religious  
Accommodation**

When scheduling unavoidably conflicts with religious holidays, which (a) require an absence from the University or (b) prohibit or require certain activities (i.e., activities that would make it impossible for the student to satisfy the academic requirements scheduled on the day(s) involved), no student will be penalized for absence because of religious reasons, and alternative means will be sought for satisfying the academic requirements involved. If a suitable arrangement cannot be worked out between the student and instructor involved, they should consult the appropriate Department Chair and, if necessary, the student's Dean.

It is the responsibility of such students to inform themselves concerning the work done in classes from which they are absent and to take appropriate action.

**Academic Integrity**

In the Faculty of Engineering, we encourage students to create a culture of honesty, trust, fairness, respect, responsibility, and courage, befitting the professional degree you are pursuing.

Please visit [Academic Integrity Western Engineering for more information](#)

**Academic Offences**

Plagiarism means using another's work without giving credit. The university has rules against plagiarism and other scholastic offences. Western Engineering has a zero-tolerance policy on plagiarism. The minimum penalty is zero on the course work and a repeat offence will earn you zero on the course. A third offence may lead to expulsion from the university.

[Scholastic Discipline for Undergraduate Students & Cheating, Plagiarism and Unauthorized Collaboration: What Students Need to Know](#)

Students must write their reports, essays and assignments in their own words. Whenever students take an idea or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. University policy states that cheating, including plagiarism, is a scholastic offence. The commission of a scholastic offence is attended by academic penalties, which might include expulsion from the program. If you are caught cheating, there will be no second warning.

All required papers may be subject to submission for textual similarity review to commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted will be included as source documents on the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between the University of Western Ontario and Turnitin.com (<http://www.turnitin.com>). Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, in the relevant section of the Academic Handbook: [http://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/scholastic\\_discipline\\_undergrad.pdf](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf)

**Faculty of  
Engineering AI  
Policy**

The use of generative Artificial intelligence (GenAI) tools won't be discouraged in the Faculty of Engineering. As we pride ourselves on building the future we can't hide from the use of GenAI tools to contribute to the understanding of the course materials. However, the

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use of GenAI tools in any assignment or contribution during the course will have to be disclosed, as a resource.

**GenAI tools use won't be permitted in any type of examination or other assessments where the faculty have prohibited their use.** If use of GenAI tools is detected by the instructor in these instances, academic offences penalties might be imposed against the student.

**Use of English Policy**

In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for improper use of English. Additionally, poorly written work except for the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

**Accessibility**

Western is committed to achieving barrier free accessibility for persons with disabilities studying, visiting and working at Western. As part of this commitment, there are a variety of services, groups and committees on campus devoted to promoting accessibility and to ensuring that individuals have equitable access to services and facilities. To help provide the best experience to all members of the campus community, please visit the [Accessibility Western University](#) for information on accessibility-related resources available at Western.

Students with disabilities may arrange for academic accommodation at Western. For a more detailed explanation, please visit [Academic Support & Engagement -Academic Accommodation](#).

**Inclusivity, Diversity, and Respect**

The Faculty of Engineering at Western University is committed to creating equitable and inclusive learning environments that value diverse perspectives and experiences. We recognize that university courses often marginalize students based on social identity characteristics such as, but not limited to, Indigeneity, race, ethnicity, nationality, ability, gender identity, gender expression, sexuality, age, language, religion, and socioeconomic status. Understanding this, we strive to facilitate equitable experiences and inclusion within the classroom by respecting and integrating multiple ways of knowing, being, and doing. Please visit the [Office of Equity, Diversity and Inclusion](#).

**Health and Well-Being**

- [Health & Wellness Services – Students](#) - Offers appointment-based medical clinic for all registered part-time and full-time students.
- [Mental Health Support](#) - Provides professional and confidential services, free of charge, to students needing assistance to meet their personal, social and academic goals. Services include consultation, referral, groups and workshops, as well as brief, change-oriented psychotherapy.
- [Crisis Support](#) - For immediate assistance, please visit Thames Hall Room 2170 or call 519-661-3030. The crisis clinic operates between 11:00 am - 4:30 pm. For after-hours crisis support, click [here](#).
- [Gender-Based Violence and Survivor Support](#) - Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced gender-based or sexual violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts, [here](#). To connect with a case manager or set up an appointment, please contact [support@uwo.ca](mailto:support@uwo.ca).

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**Important Links**

- [WESTERN ACADEMIC CALENDAR](#)
- [ACADEMIC RIGHTS AND RESPONSIBILITIES](#)
- [ENGINEERING PROGRESSION REQUIREMENTS AND ACADEMIC REGULATIONS](#)
- [UNIVERSITY STUDENTS' COUNCIL \(USC\) - SERVICES](#)
- [IMPORTANT DATES AND DEADLINES](#)
- [ACADEMIC CONSIDERATION FOR MEDICAL ILLNESS - UNDERGRADUATE STUDENTS](#)
- [ACCOMMODATIONS FOR RELIGIOUS HOLIDAYS](#)
- [SCHEDULING OF ASSIGNMENTS, TESTS, AND EXAMINATIONS](#)
- [STUDENT FORMS](#)
- [OFFICE OF THE REGISTRAR](#)
- [RETENTION OF ELECTRONIC VERSION OF COURSE OUTLINES \(SYLLABI\)](#)
- [ACADEMIC APPEALS](#)
- [STUDENT ABSENCE PORTAL](#)

**Note:** These instructions apply to all students registered in the Faculty of Engineering regardless of whether the courses are offered by the Faculty of Engineering or other faculties in the University.

**Add Deadlines:**

First term half course (i.e. “A” or “F”)	September 13, 2024
Full courses and full-year half course (i.e. “E”, “Y” or no suffix)	September 13, 2024
Second term half course (i.e. “B” or “G”)	January 14, 2025

**Drop Deadlines:**

First term half course without penalty (i.e. “A” or “F”)	November 12, 2024
Full courses and full-year half courses without penalty (i.e. “E”, “Y” or no suffix)	December 2, 2024
Second term half or second term full course without penalty (i.e. “B” or “G”)	March 7, 2025

**Contact Information:**

Undergraduate Services Office:	SEB 2097
Phone: 519-661-2130	E-mail: <a href="mailto:engugrad@uwo.ca">engugrad@uwo.ca</a>
Mechanical Engineering:	SEB 3002
Phone: 519-661-4122	E-mail: <a href="mailto:mmeundergraduate@uwo.ca">mmeundergraduate@uwo.ca</a>
Chemical & Green Process Engineering:	TEB 477
Phone: 519-661-2131	E-mail: <a href="mailto:cbeugrad@uwo.ca">cbeugrad@uwo.ca</a>
Civil Engineering:	SEB 3005
Phone: 519-661-2139	E-mail: <a href="mailto:civil@uwo.ca">civil@uwo.ca</a>
Computer, Electrical, Mechatronic Systems & Software Engineering	TEB 279
Phone: 519-661-3758	E-mail: <a href="mailto:eceugrad@uwo.ca">eceugrad@uwo.ca</a>
Integrated Engineering	ACEB 2410
Phone: 519-661-6725	E-mail: <a href="mailto:engceli@uwo.ca">engceli@uwo.ca</a>
Office of the Registrar/Student Central	WSSB 1120
Phone: 519-661-2100	