

Western University
Department of Mechanical & Materials Engineering

MME4480a – Advanced CAE: Reverse Engineering

COURSE OUTLINE – 2021-2022

**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: Professor Paul Kurowski
e-mail: pkurows@uwo.ca
Lectures: Tu 12:30-1:30 ACEB1400, Th 1:30-2:30 ACEB1400,
F 8:30- 9:30 ACEB1400
Labs: Tu 2:30-4:30 ACEB2415
Consultation: by appointment in Zoom

PREREQUISITES: MME 2259A/B or MSE 2202A/B

**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
5. Additive manufacturing
 - review of additive manufacturing technologies
 - materials
 - model preparation

- printing scanned models

**EARNING
OUTCOMES:**

Upon the successful completion of the course, students will:

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

CONTACT HOURS: 3 lecture hours, 2 laboratory hours, half course

**RECOMMENDED
TEXTS:** Raja V., Fernandes, K.J., *Reverse Engineering, an Industrial Perspective*, Springer-Verlag, 2008

EVALUATION:

The course grade will be determined as follows:

Four assignments	12%	Sep 24, Oct 22, Nov 19, Dec 3
CSWPA-SU test	12%	Nov 23
CSWA-AM test	6%	Nov 30
Mid-term examination	20%	Oct 26
Final examination	50%	During examination period

If deadlines for assignments are not met, two days grace period will be allowed with 5% penalty per day. Delay of more than two days will result in mark zero.

**COMPUTER
SOFTWARE :**

Student version of Solidworks 2021 program will be available for installation on student's computer.

**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 student misses the midterm exam without consideration, the midterm exam's mark will be zero.

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

If legitimate cause for suspicion of cheating during tests, 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.

UNITS:

SI and Imperial

ENGLISH:

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 examinations, 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.

**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.

ATTENDANCE:

Regular attendance is essential. 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 Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, the student will be debarred from taking the regular examination in the course.

SSD:

Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.

NOTE:

The above topics and outline are subject to adjustments and changes as needed. Students who have failed an Engineering course (ie.<50%) must repeat all components of the course. No special permissions will be granted enabling a student to retain laboratory, assignment or test marks from previous years. Previously completed assignments and laboratories cannot be resubmitted for grading by the student in subsequent years.

INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED

If, on medical or compassionate grounds, you are unable to write term tests or final examinations or complete course work by the due date, you should follow the instructions listed below. You should understand that academic relief will not be granted automatically on request. You must demonstrate to your department (or the Undergraduate Services Office) that there are compelling medical or compassionate grounds that can be documented before academic relief will be considered. Different regulations apply to term tests, final examinations and late assignments. Please read the instructions carefully.

NEW: Requests for Academic Consideration using the Self-Reported Absence Form

If you experience an unexpected illness or injury or an extenuating circumstance (48 hours or less) that is sufficiently severe to temporarily render you unable to meet academic requirements (e.g., attending lectures or labs, writing tests or midterm exams, completing and submitting assignments, participating in presentations) you should self-declare using the online Self-Reported Absence portal. This option should be used in situations where you expect to resume academic responsibilities within 48 hours or less.

Each student will be allowed a maximum of two self-reported absences between September and April and one self-reported absence between May and August. Self-reporting may not be used for final exams or assessments (e.g. midterm exams, tests, reports, presentations, or essays) worth more than 30% of any given course.

For full instructions about the Self-Reporting System refer to the Academic Calendar link [here](#).

A. GENERAL REGULATIONS & PROCEDURES (other than self-reported absences)

1. All first year students will report to the Undergraduate Services Office, SEB 2097, for all instances.
2. If you are an upper year student and you are missing a test/assignment/lab or examination that is worth LESS THAN 10% of your mark, you should report to your department office to request relief. If your course work is worth MORE THAN 10% of your final grade, you will report to the Undergraduate Services Office, SEB 2097.
3. Check the course outline to see if the instructor has a policy for missed tests, examinations, late assignments or attendance.
4. Documentation must be provided as soon as possible. If no one is available in your department office or the Undergraduate Services Office, leave a message clearly stating your name & student number and reason for your call. The department telephone numbers are given at the end of these instructions.
5. If you decide to write a test or an examination you should be prepared to accept the mark you earn. Rewriting tests or examinations or having the value of a test or examination reweighted on a retroactive basis is not permitted.

B. TERM/MIDTERM TESTS (other than self-reported absences)

1. If you are in first year and you are unable to write a midterm/term test, contact the Undergraduate Services Office, SEB 2097 PRIOR to the scheduled date of the test.
2. If you are an upper year student and you are unable to write a midterm/term test, inform your instructor PRIOR to the scheduled date of the test. If the instructor is not available, leave a message for him/her at the department office. If the test is worth LESS THAN 10% of your mark, you should report to your department office to request relief. If the test is worth MORE THAN 10% of your final grade you will report to the Undergraduate Services Office, SEB 2097 to request relief.
3. Be prepared to provide supporting documentation to the Department Chair and/or the Undergraduate Services Office (see next page for information on documentation).
4. Discuss with the instructor if and when the test can be rescheduled. **N.B.** The approval of the Chair or the Undergraduate Services Office is required when rescheduling midterm/term tests.

C. FINAL EXAMINATIONS (cannot be self-reported)

1. If you are unable to write a final examination, contact the Undergraduate Services Office **PRIOR TO THE SCHEDULED EXAMINATION TIME** to request permission to write a Special Final Examination. If no one is available in the Undergraduate Services Office, leave a message clearly stating your name & student number.
2. Be prepared to provide the Undergraduate Services Office with supporting documentation (see next page 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.
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 sign a "Recommendation for a Special Examination Form" available in the Undergraduate Services Office. The Undergraduate Services Office will then notify the course instructor(s) and reschedule the examination on your behalf.

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

D. 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 provide documentation if requested by the instructor (see reverse side 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.
 - i) 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.
 - ii) A Recommendation of Incomplete Form must be filled out indicating the work to be completed and the date by which it is due. This form must be signed by the student, the instructor, the department Chair and the Associate Dean, Undergraduate Studies.

E. SHORT ABSENCES

If you miss a class due to a minor illness or other problem, check your course outlines for information regarding attendance requirements and make sure you are not missing a test, laboratory or assignment. Cover any readings and arrange to borrow notes from a classmate.

F. EXTENDED ABSENCES

If you are absent more than one week or if you get too far behind to catch up, you should consider reducing your workload by dropping one or more courses. (Note drop deadlines listed below). You are strongly encouraged to seek advice from your Academic Counsellor in the Undergraduate Services Office.

G. DOCUMENTATION

If you consulted an off-campus doctor or Student Health Services regarding your illness or personal problem, **you must provide the doctor with a Student Medical Certificate** to complete at the time of your visit and then bring it to the Department (or the Undergraduate Services Office). **This note must contain the following information: severity of illness, effect on academic studies and duration of absence. Regular doctor's notes will not be accepted; only the Student Medical Certificate will be accepted.**

In Case of Serious Illness of a Family Member: Provide a Student Medical Certificate to your family member's physician to complete and bring it to the Department (or the Undergraduate Services Office if you are in first year).

In Case of a Death: Obtain a copy of the death certificate or the notice provided by the funeral director's office. You must include your relationship to the deceased and bring it to the Department (or the Undergraduate Services Office if you are in first year).

For Other Extenuating Circumstances: If you are not sure what documentation to provide, ask the Departmental Office (or the Undergraduate Services Office if you are in first year) for direction.

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

H. ACADEMIC CONCERNS

1. You need to know if your instructors have a policy on late penalties, missed tests, etc. This information may be included on the course outlines. If not, ask your instructor(s).
2. **You should also be aware of attendance requirements in some courses. You can be debarred from writing the final examination if your attendance is not satisfactory.**
3. If you are in academic difficulty, check out the minimum requirements for progression in the calendar. If in doubt, see your Academic Counsellor.

Calendar References: Check these regulations in your 2021 Western Academic Calendar available at www.westerncalendar.uwo.ca.

[Self-Reporting Absences](#)
[Absences Due to Illness](#)
[Academic Accommodations for Students with Disabilities](#)
[Academic Accommodations for Religious or Holy Days](#)
[Course Withdrawals](#)
[Examinations](#)
[Scheduling of Term Assignments](#)
[Scholastic Offences](#)
[Student Medical Certificate](#)
[Engineering Academic Regulations](#)

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.

<u>Add Deadlines:</u>	First term half course (i.e. “A” or “F”)	September 16, 2021
	Full courses and full-year half course (i.e. “E”, “Y” or no suffix)	September 16, 2021
	Second term half course (i.e. “B” or “G”)	January 11, 2022

<u>Drop Deadlines:</u>	First term half course (i.e. “A” or “F”)	November 12, 2021
	Full courses and full-year half courses (i.e. “E”, “Y” or no suffix)	November 30, 2021
	Second term half or second term full course (i.e. “B” or “G”)	March 7, 2022

Contact Information:

Undergraduate Services Office	SEB 2097 Phone: 519-661-2130	E-mail: engugrad@uwo.ca
Chemical & Green Process Engineering	TEB 477 Phone: 519-661-2131	E-mail: cbeugrad@uwo.ca
Civil Engineering:	SEB 3005 Phone: 519-661-2139	E-mail: civil@uwo.ca
Computer, Electrical, Mechatronic Systems & Software Engineering	TEB 279 Phone: 519-661-3758	E-mail: eceugrad@uwo.ca
Integrated Engineering	ACEB 2410 Phone: 519-661-6725	E-mail: engceli@uwo.ca
Mechanical Engineering	SEB 3002 Phone: 519-661-4122	E-mail: mmeundergraduate@uwo.ca

Revised 08/04/21