

MME 4459b – Advanced CAE: Manufacturing Technologies

COURSE OUTLINE - 2024-2025

CALENDAR DESCRIPTION:	This course is an introduction to modern computer aided manufacturing technologies. Topics include subtractive technologies, such as computer-numerically controlled (CNC) machining, as well as additive technologies used for rapid prototyping purposes.
COURSE INFORMATION:	Instructor: Remus Tutunea-Fatan, PhD, PEng Office: ACEB 3462; Phone 519-661-2111, ext. 88289 E-mail: rtutunea@eng.uwo.ca Timetable information is available at https://draftmyschedule.uwo.ca/
PREREQUISITES:	MME 3379A/B or MSE 3301A/B
CONSULTATION HOURS:	By advance notice via email (preferred) or drop in. Virtual meetings via Zoom are also possible.
ACCREDITATION UNITS:	Engineering Science = 100%
TOPICS:	<ol style="list-style-type: none">1. Introduction to computer-assisted manufacturing technologies<ul style="list-style-type: none">• Generalities on computer-assisted manufacturing• Subtractive and additive manufacturing processes*2. Subtractive manufacturing: computer numerically-controlled (CNC) machining<ul style="list-style-type: none">• Historical notes on CNC machining• Conventional vs. NC vs. CNC machining• Word address programming (G-code)• Milling operations• CNC position and motion control systems• Shop activities• CNC machining centers• Computer-aided part programming (CAM)3. Additive manufacturing (AM)*<ul style="list-style-type: none">• Historical notes on AM• Generic AM process• Types of AM processes• Software issues for AM• Practical applications of AM• CNC machining vs. AM <p>* AM topics make up approximately 10-15% of course content.</p>
LEARNING OUTCOMES	The Mechanical 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, assess and apply the advantages and limitations of the subtractive and additive manufacturing processes
- Know how to use and operate CNC machines and FDM 3D printers in order to fabricate geometries of a certain/limited complexity
- Evaluate and implement setups and workholding methods that allow a fast, accurate and safe generation of the intended geometry
- Select cutting tools and process parameters that are in agreement with machine tool available and surfaces/material being cut
- Use computer-aided manufacturing (CAM) software to generate tool paths to be followed by the CNC machine and/or 3D printer
- Read and troubleshoot NC programs written in standard G-code format
- Evaluate and decide among different 3D building options available when fabricating a part through FDM 3D printing
- Generate FDM 3D printer-specific command programs/codes
- Apply “design for manufacturability” (DFM) principles in routine design tasks
- Observe the principles of a safe working environment

CONTACT HOURS: 2 lecture hours/week, 2 laboratory hours/week, 0.5 course

TEXTBOOKS: No textbook is required for this course. Nonetheless, for those interested, the books listed below could provide valuable information to complement the material presented in class. Their reading and/or consultation is, however, entirely optional and not required for the purpose of this course.

- Valentino J.V., Goldenberg J., *Introduction to Computer Numerical Control (CNC)*, 5th Edition, Prentice Hall, 2013
- Gibson I., Rosen D.W., Stucker B., *3D Printing: Technology, Applications, and Selection*, CRC Press, 2018

EVALUATION: The final course grade will be determined according to the following weighting scheme:

Assignments	15%
Projects	35%
Final examination (closed book)	50%

Course assignments and projects will be handed out and collected according to the following *tentative* schedule:

Evaluation Format	Weight	Effort Type	Assigned	Due	Deadline Type
Assignment 1	10%	Individual	Week of Jan. 27	Week of Feb. 24	Flexible
Assignment 2	2.5%	Individual	Week of Mar. 3	Week of Mar. 10	Flexible

Evaluation Format	Weight	Effort Type	Assigned	Due	Deadline Type
Assignment 3	2.5%	Individual	Week of Mar. 24	Week of Mar. 31	Flexible
Project 1	10%	Team	Week of Jan. 20	Week of Feb. 3	Flexible
Project 2	15%	Team	Week of Feb. 10	Week of Mar. 10	Flexible
Project 3	10%	Team	Week of Mar. 17	Week of Mar. 31	Flexible

Term coursework topics:

- Assignment 1: Manual part programming
- Assignment 2: Machining process parameters
- Assignment 3: Motion control systems
- Project 1: Manual part programming
- Project 2: CAM software-assisted part programming
- Project 3: CNC machining vs. AM of complex surfaces

COURSE POLICIES The following course-specific policies will be enforced throughout the course:

Deliverable Deadlines

- As shown in the tentative course schedule, all deliverables have a flexible submission deadline. In this course, the flexible submission deadline is constituted by a 72-hour window immediately following the original deadline of the deliverable in which the deliverable can be submitted without late penalties. This submission deadline flexibility implies that self-attestations/undocumented absences will not be accepted for any of the course deliverables.
- Once the 72 hour no-late-penalty window has passed, late penalties of 20% per day will be applied to late submissions.
- This course has no designated assessments other than the final exam.

Course projects/laboratory sessions

- All three course projects are hands-on machining and/or 3D printing projects to be completed during the timetabled laboratory sessions.
- Due to the nature of the hands-on projects, *lab session changes (in any of the weeks of the term) are not permitted*. The structure of each team (to be determined in the first lab session) will remain the same for the entire duration of the course.
- Each team will complete the assigned project at its own speed and its own approach, such that attending a different lab session (than the one to which you are enrolled) will not receive any attendance credit. The only exception from this policy is represented by the first week of labs (the week of Jan. 10) when students can attend any timetabled lab session as long as they received permission from the course instructor.
- The hands-on component of the project will be carried out during laboratory sessions as follows: three lab sessions for Project 1 (including

the first safety/demo week), four lab sessions for Project 2 and three lab sessions for Project 3.

- Due to the high load of the CNC laboratory as well as limited amount of TA hours available for the course, non-timetabled laboratory sessions cannot be provided. Because of this, each group will have to complete the hands-on component of the project (*i.e.*, machine the required part) during the allotted timetabled lab sessions. If the project will not be completed in the allotted number of laboratory sessions, appropriate project mark penalties will have to be applied.
- Conversely, if a group will complete the hands-on component of the project in a number of sessions that is smaller than the allotted number, then group members are allowed to be absent from the rest of sessions that are allotted to that particular project (however, the supervising TA should be notified about group intention to be absent from the remainder of project-specific laboratory sessions). However, please note that – due to the inherent pacing of the course material – subsequent roll forward of the course project timelines are not possible. In other words, while each project will be assigned/announced/distributed on the same day for the entire class, its earlier completion is possible/allowed.
- Laboratory session attendance is mandatory, the only allowed exceptions being sessions that are missed with academic consideration or by means of approved self-attestations (“one per term and per course”).
- No make-up lab sessions can be offered since each lab session will be virtually different from the previous one (the project will continuously progress during the allotted weekly lab sessions).
- If a certain lab session is missed with academic consideration or with approved self-attestation, the student is advised to agree with his/her group members ways to compensate for missed project work. If no consensus is reached, the instructor might decide to penalize the student who has missed a lab session.
- If more than *one* lab session allotted to a certain project is missed *with academic consideration or with approved self-attestation*, individual penalties will likely be applied on the corresponding project mark. The amount of mark penalty will be determined by the course instructor.
- If a lab session is missed *without academic consideration or without approved self-attestation*, individual penalties will be applied on the corresponding project mark. The penalties to be applied are increasing in severity as follows: at the first unjustified/unapproved lab absence, the penalty on the project mark will be proportional with the percentage of one lab session out of the total number of lab sessions allotted to the project (*i.e.*, 33% for Project 1 and 3 and 25% for Project 2). After two unjustified/unapproved lab absences a penalty of 50% of the entire project mark (worth of 35% of the final course grade) will be applied. Three unjustified lab absences are equivalent with course failure.

Final examination

- Final examination will be closed book (all required formulas will be provided).
- Only non-programmable calculators will be allowed during the final examination.

- If a minimum of 50% is not obtained on the final examination, the student cannot receive a final mark greater than 48%.

UNITS:

Metric and US customary.

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.

ATTENDANCE

A student is entitled to be examined in courses in which registration is maintained, subject to the following limitations:

- 1) A student may be debarred from writing the final examination for failure to maintain satisfactory academic standing throughout the year.
- 2) 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 (or delegate) of the Faculty offering the course (after due warning has been given). On the recommendation of the department concerned, and with the permission of the Dean (or delegate) of that Faculty, the student will be debarred from taking the regular examination in the course. The Dean (or delegate) of the Faculty offering the course will communicate that decision to the Dean, Undergraduate of the Faculty of Registration.

POLICY ON MISSED DELIVERABLES

To avoid penalties, students missing the deadline of a deliverable designated as “mandatory” will have to report the absence by submitting an Academic Consideration Request through [Student Absence Portal](#). In this case, both the academic consideration request and supporting documentation should be submitted as soon as possible and no later than 48 hours after the deadline of the missed deliverable. Students should seek the guidance of their Academic Advisor if the request for academic consideration was not submitted timely.

For undocumented absences for deliverables that are not designated as mandatory, the Academic Consideration Request must be submitted within 48 hours from the deadline of the missed deliverable.

Requests for academic consideration must include the following components:

- a) Self-attestation signed by the student
- b) Indication of the course(s) and assessment(s) affected by the request
- c) Supporting documentation as relevant.

Requests for academic consideration without supporting documentation (“undocumented absences”) are limited to one per term and per course.

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 in the course outline, both undocumented absences and academic consideration requests with documentation may be denied.

Undocumented absences cannot be used for submitted for attempted or completed work, whether online or in-person. This includes (but is not limited to) term tests, performances, presentations, and laboratory/tutorial sessions to which the student has reported. Requests for retroactive relief are addressed in the Undergraduate Student Academic Appeals policy.

Documentation for medical illness, when required, must include the completion of a Western Student Medical Certificate (SMC) or, where that is not possible, equivalent documentation, by a health care practitioner.

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 (INC), or granting late withdrawals without academic penalty (WDN), may only be granted by the Academic Advising office of the Faculty of Registration.

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”). This assessment flexibility must be indicated on the course outline.

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.

Additional terms on academic considerations are available in Senate Academic Policies: Rights and Responsibilities - [Academic Consideration – Undergraduate Students in First Entry Programs](#) as well as on the [Office of the Registrar](#) and [Engineering Undergraduate Services](#) webpages.

Submitting fraudulent supporting documentation constitutes a scholastic offense that will be penalized with severity.

POLICY ON LATE SUBMISSIONS

To avoid penalties for late submissions, students are required to advise - **prior to due date of the deliverable** - the instructor that they will be unable to submit the deliverable on time.

If requested by the instructor, students should submit an Academic Consideration Request Form and provide documentation supporting their absence.

If an extension is granted, an individual deadline should be set by the instructor and communicated to the affected student. The approval of the Associate Chair, Undergraduate and Associate Dean, Undergraduate (“Undergraduate Program Leaders”) are required if the revised deadline was set within the examination period.

The approval of the Undergraduate Program Leaders is not required if the revised deadline was set prior to the last day of classes.

Some courses have built-in flexibility for assignment deadlines or the total number of assignments that will be graded. In these cases, the instructor might choose to deny any late submissions. Please review the course outline for details on course-specific policies and approach the instructor for additional clarifications on this matter.

***POLICY ON
MISSED FINAL
EXAMINATIONS***

Students who are unable to write the final exam are required to report their absence by submitting an Academic Consideration Request through [Student Absence Portal](#). The request for academic consideration should be submitted as soon as possible and no later than 48 hours after the missed final examination.

In case of missed final examinations, students should be prepared to provide Engineering Undergraduate Services with supporting documentation within 48 hours of the missed final examination. The following circumstances are not considered grounds for missing a final examination or requesting special examinations: common cold, headache, sleeping in, misreading/misinterpreting final examination timetable and travel arrangements.

In order to receive permission to write a Special Examination, you must obtain the approval of the Associate Dean, Undergraduate that is issued in response to the submitted Academic Consideration Request. **It is student's responsibility to find out the date, time, and location of the Special Examination** for which they were approved.

Additional terms on considerations for final exams are available on [Engineering](#) webpages.

***RELIGIOUS
ACCOMMODATIONS***

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 (or delegate) and, if necessary, the student's Dean (or delegate)

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.

Additional terms on religious accommodations are available in the Academic Handbook, Rights and Responsibilities, [Accommodation for Religious Holidays](#).

***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 additional information on this topic.

***ACADEMIC
OFFENSE***

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

POLICY ON THE USE OF GENERATIVE AI

The use of Generative Artificial Intelligence (GenAI) tools is generally permitted in the Faculty of Engineering unless otherwise stated in the course outline. Students must disclose when GenAI was used while preparing the response to a course deliverable.

Additional terms on the use of GenAI tools for coursework purposes is available on the [AI at Western](#) website.

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 WELLBEING

- [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.

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](#)

[Forms for Engineering Students](#)

[Office of the Registrar](#)

[Retention of Electronic Version of Course Outlines \(Syllabi\)](#)

[Academic Appeals](#)

[Student Absence Portal](#)

Note: These regulations apply to all students registered in the Faculty of Engineering irrespective if the course taken is offered by the home faculty or a different faculty on campus.

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:

Engineering Undergraduate Services:	SEB 2097
Phone: 519-661-2130	E-mail: engugrad@uwo.ca
Mechanical Engineering:	SEB 3002
Phone: 519-661-4122	E-mail: mmeundergraduate@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
Electrical, Mechatronics & Software Eng:	TEB 279
Phone: 519-661-3758	E-mail: eceugrad@uwo.ca
Integrated Engineering	ACEB 2410
Phone: 519-661-6725	E-mail: engceli@uwo.ca
Office of the Registrar/Student Central	WSSB 1120
Phone: 519-661-2100	