Western University
Department of Mechanical & Materials Engineering

MME 3381a - "Kinematics and Dynamics of Machines"

COURSE OUTLINE – 2024-2025

CALENDAR DESCRIPTION: Displacement, velocity and acceleration analysis of linkage mechanisms; inertia force analysis of mechanisms; balancing of reciprocating and rotating masses

COURSE INFORMATION:

Instructor: G. Daniel Langohr, PhD, PEng
Office: SEB 2063a
Email: glangohr@uwo.ca

Schedule: See Draft My Schedule

PREREQUISITES: MME 2213a/b, NMM 2270a/b or the former AM 2270a/b
ANTIREQUISITE: MSE 3381 a/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.

CONSULTATION HOURS: By advance notice via email or drop in anytime.

ACCREDITATION UNITS: Engineering Science = 75%, Engineering Design = 25%

TOPICS:

- Fundamentals of mechanical vibrations
- Fundamentals of mechanisms and machines
- Techniques in geometric constraint programming
- Planar linkage design
- Graphical position, velocity, and acceleration analysis
- Design and analysis of cam-based mechanisms
- Design and analysis of gear-based mechanisms
- Static and dynamic force analysis of mechanisms
- Dynamic force analysis
- Balancing of rotating and reciprocating machines

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 successful completion of this course, students will:

- Understand the fundamental principles of vibratory motion (KB1, KB2, KB3, PA1, PA2, IN2, IN3)
- Understand and assess the functionality of a mechanism (KB3)
- Select or design a mechanism for a specific purpose (DE1, DE2)
- Analyze the position, velocity and acceleration of a linkage using graphical, analytical and computer-based methods (KB3, PA1, PA2, ET2)
- Model and analyze a mechanism using motion simulation software (PA1, PA2, ET1, ET2)
- Use hand calculations, computer simulation, and experiments in designing and analyzing machines (IN1, IN2, PA1, PA2, ET1, ET2)
- Verify, compare and interpret differences between the results obtained through different means of analysis (IN3, PA3, ET1, ET2, CS3)
- Evaluate the implications of an incorrect mechanism design (PA3)

CONTACT HOURS:

3 lecture hours, 2 tutorial hours, 0.5 laboratory hours, half course

RECOMMENDED TEXTBOOKS:

Waldron K.J., Kinzel G.L., Agrawal S.K., *Kinematics, Dynamics, and Design of Machinery*, 3rd Edition, Wiley, 2016

EVALUATION:

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

Eight in-tutorial assignments (open book)	10%
One take home assignment	5%
SolidWorks motion analysis tutorials (pre-project)	5%
Project	15%
Laboratory session	5%
Two quizzes (closed book)	20%
Final examination (closed book)	40%

Quizzes, projects and laboratories will be carried out according to the following *tentative* schedule:

Evaluation Format	Weight	Effort Type	Assigned	Due
Eight in-tutorial assignments	10% (1.25% each)	Team*	Weekly except for the first two weeks, reading week, and the two quizzes.	End of tutorial hour in which assigned
Pre-project	5%	Team*	Week of Sep. 16	Week of Sep. 30
Quiz 1	10%	Individual	Week of Oct. 21	
Project	15%	Team*	Week of Oct. 7	Week of Dec. 2
Assignment (peer-graded, includes Part 1 and Part 2)	5%	Team*	Week of Oct. 14	Week of Nov. 25
Quiz 2	10%	Individual	Week of Nov. 11 (Designated Assessment)	

Evaluation Format	Weight	Effort Type	Assigned	Due
Lab	5%	Group**	Week of Nov. 18	Week of Nov. 25
Final exam	40%	Individual	TBA (Dec. examination period)	

* Team is student-formed (same team throughout the entire course)
** Group is instructor-formed (applies just to the lab session)

COURSE POLICIES

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

Laboratory sessions

- Students must attend the laboratory session for which they have signed up.
- Failure to pass the laboratory component of the course will result in automatic course failure.
- Passing of the laboratory component is equivalent with obtaining more than 50% on the laboratory component of the course.
- A maximum of **one** make-up session will be offered to students who have missed a laboratory session with academic consideration.
- All approved make-up laboratory sessions will be offered in the final week of the term.
- Missing a laboratory session **without** academic consideration will translate into a zero mark for that laboratory session.

- When academic consideration has been obtained for a particular laboratory session, it is student's responsibility to contact *timely* (*i.e.*, within maximum three days after consideration has been obtained) the instructor of the course in order to seek alternate arrangements for the missed laboratory session.
- The default assumption is that everyone contributes equally to the lab team effort and hence everyone should receive the same mark for the common team submission.
- Please note that whenever individual contributions to the team effort are not equitably shared by the team members, individual adjustments of the marks might occur at the discretion of the instructional team of the course (*i.e.*, course instructor and teaching assistants).
- 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.

Quizzes

- The quizzes will take place during the scheduled tutorial sessions.
- Quizzes will be closed book.
- Quiz 2 is the designated assessment and as such will require medical documentation for academic consideration.
- Each quiz will be approximately 1.5 hours long with the reminder of tutorial time used to discuss the quiz solution.
- Missing a quiz **without** academic consideration will translate into a zero mark for that quiz.
- **No make-up quiz** will be offered to those who miss it with academic consideration. The weighting of the quizzes missed with consideration will be shifted automatically to the final exam. There will be no exceptions!
- Academic consideration for quizzes (greater than or equal 10% weight) can be obtained from Engineering Undergraduate Services.
- 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.

Pre-project/Project

- Project teams will be formed in the first week of classes via OWL sign-up.
- Failure to pass the project component of the course will result in automatic course failure.
- The maximum team size will be three students, while the minimum team size will be two students.
- The same project team will also work on the eight in-tutorial assignments scheduled throughout the term.
- Once the team formation deadline has passed, team membership cannot be changed.
- SolidWorks will be used for the kinematic analysis of the mechanism generated for project purposes.

- The default assumption is that everyone contributes equally to the project team effort and hence everyone should receive the same mark for the common team submission.
- Please note that whenever individual contributions to the team effort are not equitably shared by the team members, individual adjustments of the marks might occur at the discretion of the instructional team of the course (*i.e.*, course instructor and teaching assistants).
- 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.

In-Tutorial Assignments

- **In-tutorial assignments will take place during the second hour of the tutorials.**
- The assignments will consist of problems to be solved by the same team formed for pre-project/project purposes.
- The instructor of the course will solve problems during the first tutorial hour. Problems like them will constitute the subject of the in-tutorial assignment assigned in the second hour of the tutorial.
- Teams will receive problem solving assistance from TAs and instructor who will be in the tutorial room. However, prior knowledge on problems assigned (like the ones solved by the instructor in the preceding week) will be highly beneficial.
- No make-up sessions will be offered for those missing the in-tutorial assignment (irrespective of the reason).
- If the in-tutorial assignment is missed **with** academic consideration, then its weight will be equally distributed over the completed assignments.
- If the in-tutorial assignment is missed **without** academic consideration, then its mark will be zero.
- Academic consideration for in-tutorial assignments (under 5% individual weight) can be obtained from the MME Undergraduate Coordinator.
- The default assumption is that everyone contributes equally to the in-tutorial assignment team effort and hence everyone should receive the same mark for the common team submission.
- Please note that whenever individual contributions to the team effort are not equitably shared by the team members, individual adjustments of the marks might occur at the discretion of the instructional team of the course (*i.e.*, course instructor and teaching assistants).
- 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.

Peer-Graded Assignment

- The assignment will consist of two separate, but interconnected parts: Part 1 will require the team to work together and complete the required deliverable(s) whereas Part 2 will require each team member to review and grade/rank the deliverables submitted by all other teams in the class.
- Part 1 will be graded by the rest of the class ("peer-graded assignment").
- Part 2 will not receive any marks, but those who will not submit timely their ranking of Part 1 submissions will incur individual late penalties of 20% per day for the peer-graded assignment (even if Part 1 was submitted on time by the team).
- The default assumption is that everyone contributes equally to the project team effort and hence everyone should receive the same mark for the common team submission.
- Please note that whenever individual contributions to the team effort are not equitably shared by the team members, individual adjustments of the marks might occur at the discretion of the instructional team of the course (*i.e.*, course instructor and teaching assistants).
- 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.

Term work

- If a minimum of 50% is not obtained on the term work (assignments, quizzes, pre-project, project, and laboratory sessions), the student will fail the course regardless of the mark obtained on the final examination.
- Please note that whenever possible, due warning on this topic will be given. However, since the project (15% weight) is due in the final day of classes, it is possible that accurate calculations will not be possible until final grades are calculated.
- No appeals on this topic will be accepted, such that students are strongly encouraged to self-monitor their academic progress in the course throughout the term.

Final examination

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

Submissions

- In-tutorial assignments are due at the end of the tutorial hour in which they were assigned. No late submissions will be accepted.
- Lab reports will be due at the end of the lab session in which data was provided and was processed. No late submissions will be accepted.
- Late submissions of the pre-project will be penalized with 20% per day.

	• Late submissions of the project will be penalized with 20% per day. • The final examination will have a total duration of three hours. • 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:	Metric and US customary.
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.
USE OF AI:	The use of generative artificial intelligence is not officially prohibited in this course, however if it is used in the production of any materials submitted for marks in the context of this course, its use must be disclosed in full. This includes, for example, the use of AI tools for text generation, editing, and/or refinement.

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	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.
Missed/Late Accommodation Policy	1. Students missing a test/assignment/lab or examination you will report the absence by submitting an Academic Consideration Request form through STUDENT ABSENCE PORTAL. 2. **Documentation must be provided as soon as possible.**
Exam Accommodation	1. If you are unable to write a final examination, report your absence using the Academic Consideration Request Form through STUDENT ABSENCE PORTAL. 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.

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 STUDENT ABSENCE PORTAL.

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

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.

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

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 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 assistant, 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**
- **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: 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
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
Office of the Registrar/Student Central	WSSB 1120
Phone: 519-661-2100	