Western University
Faculty of Engineering
Mechatronic Systems Engineering Program

MSE 3381A – Kinematics and Dynamics of Machines

Course Outline 2022-23

Description:

Displacement, velocity and acceleration analysis of linkages; static and dynamic force analysis of mechanisms; balancing of reciprocating and rotating masses; special-purpose joints and mechanisms.

Instructor: Dr. G. Daniel Langohr, Ph.D, PEng
SEB 2063A, 519-661-2111 ext.84859, glangohr@uwo.ca
Consultation hours: drop in, by appointment, or scheduled tutorial hours

Lectures: W 8:30 am – 9:30 am (SEB 2202)
Th 2:30 pm – 3:30 pm (SEB 2202)
Th 5:30 am – 6:30 am (SEB 2100)

Tutorials: F 12:30 pm – 2:30 pm (ACEB 1450)

Labs: M 8:30 pm – 11:30 pm (SEB 3105a)
M 12:30 pm – 3:30 pm (SEB 3105a)
Tu 9:30 am – 12:30 pm (SEB 3105a)

Contact Hours:

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

Antirequisite:

MME 3381A/B

Prerequisites:

MSE 2213A/B or MME 2213A/B, NMM 2270A/B or the former AM 2270A/B.

Co-requisite:

MME 3381A/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 in the event that you are dropped from a course for failing to have the necessary prerequisites.

CEAB Academic Units:

Engineering Science: 75%, Engineering Design: 25%

Recommended Textbooks:

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

Required Software:

SIMULIA SolidWorks 2021/2022 (for project)

Other Required References:

None.

Recommended References:

None.

General Learning Objectives (CEAB Graduate Attributes)

Knowledge Base	D	Use of Engineering Tools	D	Impact on Society and the Environment	I
Problem Analysis	D	Individual and Teamwork	D	Ethics and Equity	
Investigation	I	Communication Skills		Economics and Project Management	
Design	I	Professionalism		Life-Long Learning	

Notation: *x* represents the content level code as defined by the CEAB. blank = not applicable; I = introduced (introductory); D = developed (intermediate) and A = applied (advanced).

Topics and Specific Learning Objectives

- 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

Upon successful completion of the course, students will:

- Understand and assess the functionality of a mechanism
- Select or design a mechanism for a specific purpose

- Analyze the position, velocity and acceleration of a linkage using graphical, analytical, and computer-based methods
- Model and analyze a mechanism using motion simulation software
- Use hand calculations, computer simulation, and experiments in designing and analyzing machines
- Verify, compare, and interpret differences between the results obtained through different means of analysis
- Evaluate the implications of an incorrect mechanism design
- Manage and apply the principles of effective team interaction: organization, management, and motivation

Evaluation

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

Weekly in-tutorial assignments (8)	10%
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 the lab 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 Sep. 9, Sep. 16, Oct. 7, and Oct. 28	End of tutorial hour in which is assigned
Pre-project	5%	Team*	Week of Sep. 19	Week of Oct. 5
Quiz 1	10%	Individual	Oct. 7	
Quiz 2	10%	Individual	Oct. 28	
Assignment (peer-graded)	5%	Team*	Week of Oct. 17	Week of Nov. 28
Lab	5%	Group**	Week of Nov. 21	Week of Nov. 28
Project	15%	Team*	Week of Oct. 10th	Week of Dec. 5th

* Team is student-formed (same team throughout the entire course)

** Group is instructor-formed (applies just to the lab)

Course Policies:

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

Laboratory session

- All students are to attend the laboratory session to which they signed up.
- Failure to pass the laboratory component of the course will attract 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 of 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 from the Engineering Undergraduate Services Office) the instructor of the course to seek alternate arrangements for the missed laboratory session.
- 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.
- 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 quizzes will be offered** to students who have missed any of the scheduled quizzes **regardless of academic consideration**.
- The weighting of missed quizzes will automatically be shifted to the final exam.
- 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.

Project & Pre-Project

- Project teams will be formed in the first week of classes via OWL sign-up.
- The maximum team size will be three students, while the minimum team size will be two students.
- Students who do not choose a team will be assigned to one.
- 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 team effort (*i.e.*, project and labs) 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 project-solving 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 for the following week.
- Teams will receive problem solving assistance from TA 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, the weighting allotted to in-tutorial assignments will be calculated as the average of the remaining assignments.
- If the in-tutorial assignment is missed **without** academic consideration, then the mark for the missed assignment will be zero.
- Academic consideration for in-tutorial assignments (under 5% individual weight) can 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.

Term work

- If a minimum of 60% is not obtained on term work (quizzes, pre-project, project, in-tutorial assignments, and laboratory sessions), the student will fail the course irrespective of the mark obtained in the final examination.
- Please note that whenever possible, due warning on this topic will be given. However, since the term 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

- 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%.

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 tutorials will be penalized with 20% per day.
- Late submissions of the project will be penalized with 20% per day.
- 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.

Use of 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 with the exception of 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.

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:

Any student who, in the opinion of the instructor, is absent too frequently from class, laboratory, or tutorial periods will be reported to the Dean (after due warning has been given). On the recommendation of the department, and with the permission of the Dean, the student will be debarred from taking the regular final examination in the course.

Accommodation Policies:

Students with disabilities work with Accessible Education (formerly SSD) which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The accommodation policy can be found here: Academic Accommodation for Students with Disabilities.

Absence Due to Illness or Other Circumstances:

Students should immediately consult with the instructor or program Director if they have any problems that could affect their performance in the course. Where appropriate, the problems should be documented (see the attached “Instructions for Students Unable to Write Tests or Examinations or Submit Assignments as Scheduled”). The student should seek advice from the instructor or program Director regarding how best to deal with the problem. Failure to notify the instructor or

program Director immediately (or as soon as possible thereafter) will have a negative effect on any appeal.
For more information concerning medical accommodations, see the relevant section of the Academic Handbook:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf

For more information concerning accommodations for religious holidays, see the relevant section of the Academic Handbook:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf

Religious Accommodation

Students should consult the University's list of recognized religious holidays, and should give reasonable notice in writing, prior to the holiday, to the Instructor and an Academic Counsellor if their course requirements will be affected by a religious observance. Additional information is given in the Western Multicultural Calendar.

~~Use of Recordings~~

~~**All of the remote learning sessions for this course will be recorded.** The data captured during these recordings may include your image, voice recordings, chat logs and personal identifiers (name displayed on the screen). The recordings will be used for educational purposes related to this course, including evaluations. The recordings may be disclosed to other individuals under special circumstances. Please contact the instructor if you have any concerns related to session recordings.~~

~~Participants in this course are not permitted to record the sessions, except where recording is an approved accommodation, or the participant has the prior written permission of the instructor.~~

Cheating and Plagiarism:

Students must write their 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

Use of Electronic Devices:

You are permitted to use electronic devices including smartphones, tablets and laptops during class for course-related activities only. This includes but is not limited to: viewing lecture PowerPoints, viewing other course documents, accessing OWL, posting questions, collaborating in group activities, and running SolidWorks.

Policy on Repeating All Components of a Course:

Students who have failed an Engineering course (i.e. < 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.

Internet and Electronic Mail:

Students are responsible for regularly checking their Western e-mail and the course web site (https://owl.uwo.ca/portal/) and making themselves aware of any information that is posted about the course. If the student fails to act on information that has been posted on these sites and does so without a legitimate explanation (i.e., those covered under the illness/compassionate form), then there are NO grounds for an appeal.

Accessibility:

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 519-661-2111 ext. 82147 for any specific question regarding an accommodation.

Support Services:

Office of the Registrar, http://www.registrar.uwo.ca/

Student Development Centre, http://www.sdc.uwo.ca/

Engineering Undergraduate Services, http://www.eng.uwo.ca/undergraduate/

USC Student Support Services, http://westernusc.ca/services/

Students who are in emotional/mental distress should refer to Mental Health @ Western, http://www.health.uwo.ca/mental_health/, for a complete list of options about how to obtain help.