

**Western University
Faculty of Engineering
Mechatronic Systems Engineering Program**

MSE 3381A – Kinematics and Dynamics of Machines

Course Outline 2016-17

Description:

In this course, students will learn and apply a systematic approach to the selection, synthesis, analysis, application and evaluation of common mechanisms and machines for engineering applications.

Instructor:

Dr. R.O. Buchal, Ph.D., P.Eng.

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Consultation hours: Tuesday and Thursday 1:30pm-2:30pm or by appointment

Academic Calendar Copy:

Displacement, velocity and acceleration analysis of linkage mechanisms; inertia force analysis of mechanisms; balancing of reciprocating and rotating masses; free and harmonic vibrations of single degree of freedom systems.

Contact Hours:

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

Antirequisite:

MME 3381a/b

Prerequisites:

ES 1022a/b/y, MME 2213a/b or MSE 2213a/b, AM 2413 or 2415

Co-requisite:

None

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%.

Required Textbook:

Norton, Robert L., Design of Machinery, Fifth Edition, McGraw Hill, 2012.

Required Software:

SolidWorks 2016 will be used extensively in this course. This is available in the computer labs, and may be installed on your own computer under our campus license. The installation files can be downloaded from the Engineering Distro drive.

Other Required References:

None.

Recommended References:

None.

General Learning Objectives (CEAB Graduate Attributes)

Knowledge Base	2/2	Use of Engineering Tools	3/2	Impact on Society and the Environment	N/A
Problem Analysis	2/2	Individual and Team Work	2/2	Ethics and Equity	N/A
Investigation	2/2	Communication Skills	2/2	Economics and Project Management	2/2
Design	3/2	Professionalism	2/2	Life-Long Learning	2/2

Notation: x/y , where x is the cognitive level (1: Remember/Understand, 2: Apply/Analyze, 3: Evaluate/Create) at which the attribute is assessed and y is the academic level (1: Beginner, 2: Intermediate, 3: Advanced) at which the attribute is assessed.

Topics and Specific Learning Objectives

Fundamentals of mechanisms and machines

At the end of this section, students will be able to:

- Understand and explain the history, relevance and applications of mechanisms and machines
- Understand and explain the fundamental concepts of mechanisms and machines
- Classify and categorize types of mechanisms and machines

Graphical and analytical synthesis of planar linkages

At the end of this section, students will be able to:

- Design (synthesize) a planar linkage mechanism to produce a desired motion.
- Select and modify an appropriate known linkage mechanism to produce a desired motion.
- Understand the capabilities and limitations of planar 1-DOF linkage mechanisms

Position, velocity and acceleration analysis of planar linkages

At the end of this section, students will be able to:

- Determine the positions of all of the links of a planar linkage as a function of the input position.
- Determine the velocities of all of the links as a function of the input position and velocity.
- Determine the accelerations of all of the links as a function of the input position, velocity and acceleration.
- Compare and contrast graphical, analytical and computer-based analysis methods.

Design and analysis of cams

At the end of this section, students will be able to:

- Design and analyze cam-follower systems for typical applications
- Understand and explain cam terminology
- Compare and contrast cam-followers with alternatives like linkages for specific applications

Design and analysis of gear trains

At the end of this section, students will be able to:

- Design and analyze gear trains for typical applications
- Understand and explain gear basics and terminology

Dynamics fundamentals

At the end of this section, students will be able to:

- Design and analyze gear trains for typical applications
- Understand and explain basic dynamics concepts and terminology as applied to machines

Dynamic force analysis

At the end of this section, students will be able to:

- Determine the actuator torques and forces required to generate a desired motion of a planar linkage.
- Determine the joint reaction forces resulting from a desired motion.
- Determine the motion resulting from application of a given actuator torque or force
- Determine the shaking forces and moments of a machine

Balancing of rotating and reciprocating machines

At the end of this section, students will be able to:

- Balance a rotating machine to eliminate shaking forces and moments

Vibration analysis

At the end of this section, students will be able to:

- Understand and explain the basic concepts of single-degree-of-freedom spring-mass-damper system
- Model and analyse a single-DOF system mathematically
- Model and simulate a single-DOF system using a computer (SolidWorks)
- Model and simulate modes of vibration of a flexible body
- Recognize and explain the validity and limitations of rigid-body assumptions in real engineering applications

Computer modeling, simulation and analysis of machines

At the end of this section, students will be able to:

- Model and simulate a variety of mechanisms and machines using SolidWorks
- Compare and contrast the use of hand calculations, computer simulation, and experiments in designing and analyzing machines

Evaluation

Description	Weight	Due Date
Weekly individual assignments	Eight (8) equally weighted assignments, 20% of total mark	Weekly starting September 21, ending November 9
Labs	Two labs, equally weighted, 10% of total mark.	Weeks of November 14 and November 21
Group project	20%	Last week of classes
Final Examination	50%	TBA

If a student is excused from writing a midterm or quiz for legitimate reasons, and with the approval of the Department Chair, the weighting of the final examination can be adjusted accordingly.

To obtain a passing grade in the course, a mark of 50% or more must be achieved on the final examination. A final examination mark $< 50\%$ will result in a final course grade of 48% or less.

Homework Assignments:

There will be eight (8) homework assignments. Completed assignments will be submitted either electronically through OWL, or on paper to the course locker.

Laboratory:

There will be two laboratories. Each lab will be completed by a group of three students. The labs are scheduled for the second and third week of November.

Final Examination:

The final examination will be take place during the regular examination period. The examination will be **LIMITED OPEN BOOK**. **Instructor prepared formula information sheet will be provided during the final examination.**

Late Submission Policy:

The penalty for late assignments will be 10% per day late, and assignments that are more than 3 days late will not be marked and will receive a grade of zero.

Assignment Submission Locker:

TBA.

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.

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.

Absence Due to Illness or Other Circumstances:

Students should immediately consult with the instructor or department Chair 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 department Chair regarding how best to deal with the problem. Failure to notify the instructor or department Chair 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

Missed Midterm Examinations:

If a student misses a midterm examination, the exam will not be rescheduled. The student must follow the Instructions for Students Unable to Write Tests and provide documentation to their department within 24 hours of the missed test. The department will decide whether to allow the reweighting of the test, where reweighting means the marks normally allotted for the midterm will be added to the final exam. If no reasonable justification for missing the test can be found, then the student will receive a mark of zero for the test.

If a student is going to miss the midterm examination for religious reasons, they must inform the instructor in writing within 48 hours of the announcement of the exam date or they will be required to write the exam.

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 are required to repeat an Engineering course 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 by the student for grading 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.

**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 accommodation will not be granted automatically on request. You must demonstrate to your department (or the Undergraduate Services office if you are in first year) that there are compelling medical or compassionate grounds that can be documented before academic accommodation will be considered. Different regulations apply to term tests, final examinations and late assignments. Read the instructions carefully. (see the 2016 Western [Academic Calendar](#)).

A. GENERAL REGULATIONS & PROCEDURES

1. Check the course outline to see if the instructor has a policy for missed tests, examinations, late assignments or attendance.
2. Bring your request for academic accommodation to the attention of the Chair of the department (or the Undergraduate Services office if you are in first year) prior to the scheduled time of the test or final examination or due date of the assignment. If you are unable to contact the relevant person, leave a message with the appropriate department (or Undergraduate Services office, if you are in first year). The addresses, telephone and fax numbers are given at the end of these instructions. Documentation must be provided as soon as possible.
3. 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 exam reweighted on a retroactive basis is not permitted.

B. TERM TESTS

1. If you are unable to write a term test, inform your instructor and the Chair of your Department (or the Undergraduate Services Office if you are in first year) prior to the scheduled date of the test. If the instructor is not available, leave a message for him/her at the department office and inform the Chair of the Department (or the Undergraduate Services Office if you are in first year).
2. Be prepared to provide supporting documentation to the Chair and the Undergraduate Services Office (see next page for information on documentation).
3. Discuss with the instructor if and when the test can be rescheduled. **N.B.** The approval of the Chair (or the Undergraduate Services Office if you are in first year) is required when rescheduling term tests.

C. FINAL EXAMINATIONS

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 (please spell your full name).
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, 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.

N.B. 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 Associate Dean 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. 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.

SHORT ABSENCES

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

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 may want to seek advice from the academic counsellor in your Department or the counsellors in the Undergraduate Services Office if you are in first year.

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 if you are in first year). **This note must contain the following information: severity of illness, effect on academic studies and duration of absence.**

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).

ACADEMIC CONCERNS

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).

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.

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 2016 Western Academic Calendar available at www.westerncalendar.uwo.ca.

[Absences Due to Illness](#) - page 117

[Academic Accommodations for Students with Disabilities](#) - page 118

[Academic Accommodations for Religious Holidays](#) - page 119

[Incomplete Standing](#) - page 104

[Scheduling of Term Assignments](#) – page 97

[Scholastic Offences](#) - page 113

[Special Examinations](#) - page 132

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>Drop Deadlines:</u>	First term half course (i.e. "A" or "F"):	November 5, 2016
	Full courses and full-year half courses (i.e. "E", "Y" or no suffix):	November 30, 2016
	Second term half or second term full course (i.e. "B" or "G"):	March 7, 2017

Undergraduate Services Office:	SEB 2097	telephone: (519) 661-2130	fax: (519) 661-3757
Dept. of Chemical and Biochemical Engineering:	TEB 477	telephone: (519) 661-2131	fax: (519) 661-3498
Dept. of Civil and Environmental Engineering:	SEB 3005	telephone: (519) 661-2139	fax: (519) 661-3779
Dept. of Electrical and Computer Engineering, Software Engineering Mechatronics Engineering	TEB 279	telephone: (519) 661-3758	fax: (519) 850-2436
Dept. of Mechanical and Materials Engineering:	SEB 3002	telephone: (519) 661-4122	fax: (519) 661-3020