University of Guelph
School of Engineering
ENGG*2340, Kinematics and Dynamics
Winter-2012 Course Outline

Instructor

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Office Hours:	Tuesday 11:00 AM – 2:00 PM; Room THRN 2403

Graduate Teaching Assistants

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Schedules

Lecture: Monday, Wednesday, Friday; 11:30 AM - 12:20 PM; MACK, Room 117

Lab-Section 101: Monday 02:30PM - 05:20PM

Lab-Section 102: Tuesday 08:30AM - 11:20AM

Lab-Section 104: Thursday 11:30AM - 02:20PM

Lab-Section 105: Friday 02:30PM - 05:20PM

The first five labs are in THRN Room 1313 and the last three labs will be in RHRN Room 1007

Lab begins in the week of 23rd January, 2012

Calendar Description

The course will cover kinematics and dynamic analysis including graphical and analytical methods for kinematics analysis of mechanisms and elementary body motion, static and dynamic force analyses of mechanisms, gyroscopic forces, dynamics of reciprocating and rotating machinery, cam and gear mechanisms and specifications. Vibration analysis will deal with free

and forced vibration of underdamped lumped systems with multidegrees of freedom, analytical and numerical techniques of solution, viscous damping, vibration isolation, vibration measurement and control. *Prerequisite(s):* ENGG*2160

Text Book

John J. Uicker, JR., Gordon R. Pennock, and Joseph E., Shigley (2010). Theory of machines and mechanisms, 4ed, OXFORD University Press, New York.

Note: The lecture is the primary source of information for the course and discussions will me more elaborated than presented in the text book. Examples that may not be available from the text book may also be presented during the lecture time to further help you understand the subject matter of the topics discussed. As such it is highly recommended that you attend the lectures.

Course Learning Outcomes:

Graduate attributes	**In completing this course, you will**
3.1.1 A knowledge base for engineering	• Know both graphical and analytical vector analysis for the determination of displacement, velocity and acceleration of components of various mechanisms. • Use differential equations in determining responses to external excitation of vibrating bodies • Use kinematics coefficient method for cam-follower analysis and planetary gear train analysis.
3.1.2 Problem analysis	• Apply the concepts of displacement, velocity, and acceleration to analyse mechanism problems of machineries. • Analyse both static and dynamic forces on machine components • Understand the dynamics of vibration and its isolation
3.1.3 Investigation	• Investigate if there is a knocking problem in a cam-follower operation
3.1.4 Design	• Be able to determine the required damping coefficient and sprig constant to minimize the negative effect of vibration • Be able to determine spring constant and required unbalanced mass to generate a required vibration • Be able to develop a cam profile given the required displacement of a follower
3.1.5 Use of engineering tools	• Solve kinematics problems with MATLAB and WORKING MODEL 2D
3.1.6 Individual and team work	• Complete kinematics analysis problems both individually and through cooperation with other peoples in your team

3.1.7 Communication skills	• Generate and present clear and accurate calculation results and present well documented assignment, laboratory and project reports
3.1.8 Professionalism	• Develop courtesy and professionalism to colleagues and the instructor through attentiveness in class, and non-judgemental participation in class discussions or in collaboration on group assignments and projects
3.1.9 Impact of engineering on society and the environment	
3.1.10 Ethics and equity	Complete assigned work and exams without academic dishonesty such as copying and submitting the work of others as your own
3.1.11 Economics and project management	
3.1.12 Lifelong learning	Become conscious of gaps in your knowledge of mechanism of machinery (even if you passed this course with A+) when you encounter sophisticated mechanism in real world which have not been covered in the course (or not presented in most standard text books). Through this consciousness and fundamental skills you get from this course, you will be able to analyze complicated mechanisms of machineries in real life applications.

Detail Course Outline

General Outline	Topics
1. Introduction	Revision of kinematics of rigid bodies from ENGG*1210
2. Velocity Analysis	Velocity difference equation
	Velocity polygons (Graphical Solution)
	Apparent velocity equation
	Direct and Rolling contact velocity
	Instantaneous center of velocity
	Use of instantaneous centers to find velocity
3. Acceleration Analysis	Acceleration difference equation
	Acceleration polygon (Graphical Solution)
	Apparent acceleration equation and Coriolis component of acceleration
	Direct and rolling contact acceleration
4. Dynamic Force Analysis	D'Alembert's Principle
	Dynamic forces in machine members

	Dynamic Balancing
5. Cam Analysis	Introduction to cam design
	Classification of cams and followers
	Displacement Diagram
	Graphical layout of cam profile
6. Gear Design	Spur Gear Terminology and definition
	Fundamental law of Toothed Gearing
	Involutes property
	Fundamentals of Gear-Tooth action
	Contact ratio
	Varying the center distance
	Involutomery
	Introduction to helical, bevel and worm gears
7. Gear Trains	Parallel-axis gear trains
	Example of gear trains
	Determining tooth numbers
	Analysis of epicyclic gear trains
	Bevel gear epicyclic train
8. Vibration Analysis	Differential equations of motion
	A vertical model
	Solution of the differential equation
	Step input forcing
	Phase-plane analysis
	Free vibration with viscous damping
	Response to periodic forcing
	Harmonic forcing
	Forcing caused by unbalance
	Relative motion
	Isolation
	Rayleigh's method

Instructional Methods

Instructional methods include lectures and problem solving and laboratory periods. For the first several weeks, the labs are mainly in a computer room (Room 1313) and involve the use of MATLAB and Working Model 2D for kinematics and dynamics analysis of mechanisms and AutoCAD for graphical solution. In the last few weeks, the labs will involve experimentation on dynamic balancing, cams, gears and vibration analysis. Problems will be assigned for homework and solving these assignment problems is highly essential to reach the learning objective if carried out under your own steam..

Attendance

The best leaning experience will be achieved if you ***attend lecture and lab regularly***. Scientific studies have proven that a student success rate is strongly related to his/her class attendance. Those who attend classes and tutorials have higher success rates than those who do not.

Class Participation

Students are encouraged and expected to actively participate in class. You can use laptop or tablets in class, but only for following along with the class notes — please, no web surfing, e-mailing, instant-messaging, etc., as such is very distracting to those around you, and obviously to you. Turn-off all cell phones, phones, blackberries, etc. during class ... putting on vibrate may not be enough. Out of respect to your classmates please keep your private discussions outside the classroom.

Grading Scheme:

Assignments (Graphical Solution using AutoCAD, Analytical Solution using Hand Calculation, MatLab, Working Model 2D)	10%
LAB Exercises	10%
In-class quizzes (5 to 8quizzes, one problem and 20 minutes long each)	20%
Mid-term Exam	20%
Final Exam	40%

Late Assignment/Missed Test Policy:

Generally, when you find yourself unable to meet a course requirement such as an assignment, LAB or a test as a result of compassionate, illness or physiological reasons, a formal explanation must be made in writing to the instructor and (where possible) proper documentation must be provided. This should be done prior to an exam or assignment or LAB period (if possible) or as soon as possible but definitely within a week after the exam or assignment due date or the Lab is conducted. If no explanations are provided, exams receive a grade of zero and assignments/lab reports are subject to the following deductions:

- 25% will be deducted if the assignment is up to 24 hours late,
- 50% will be deducted if the assignment is 24 to 48 hours late,
- No assignments will be accepted after that.

Assignments will be collected during lecture time at their due dates and will be returned to you during LAB periods. Assignment marks will be posted on CourseLink. It is your responsibility to continually check your mark records on the CourseLink and you may appeal any mark for an assignment within one week after the marked assignments are returned to the class. Solutions of assignment problems will be posted on CourseLink.

Exam Dates:

- Mid-term exam will be outside the regular lecture hours; **Saturday, 10:00AM – 12:00PM, March 3, 2012** (Room - TBA).
- Final Exam will be on Wed. 2012/04/11,07:00PM - 09:00PM, Room TBA

University Policy on Academic Misconduct:

Academic misconduct, such as plagiarism, is a serious offence at the University of Guelph. Please consult the Undergraduate Calendar 2011-2012 and School of Engineering programs guide, for offences, penalties and procedures relating to academic misconduct.
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/pdffiles/calendar.pdf

Disclaimer:

The instructor reserves the right to change any or all of the above in the event circumstances, subject to the University of Guelph Academic Regulations.