ME 301 Kinematics & Dynamics of Machines

COURSE OBJECTIVES

Dr. Bob Williams 259 Stocker, 3-1096 williar4@ohio.edu	Winter 2009 Call # 04538 www.ent.ohiou.edu/~bobw

The objectives of this course are to cover the kinematics and dynamics of planar single degree-of-freedom mechanisms. After this course, the student should have general mathematical and computer skills to enable high-fidelity kinematics and dynamics analysis of machine elements including linkages, cams, and gears, within the general machine design context. The methods used in this course are general vector/matrix analysis techniques that can be applied in the future to any planar mechanism, not only the example mechanisms presented in class. A side-objective is to introduce the use of Matlab as a powerful software tool in programming analysis equations. The course project is intended to have each student team apply the class principles in real-world mechanisms. This course provides practice in technical writing (weekly homework memos and final project report) and practice in technical presentation (final project presented orally to the class). Specific topics include:

1) Common mechanisms used in machines and everyday life.

2) Calculation of mobility (number of degrees-of-freedom). Enumeration of rigid links and types of joints within mechanisms.

3) Complete (translational and rotational) mechanism position analysis.

4) Complete (translational and rotational) mechanism velocity analysis.

5) Complete (translational and rotational) mechanism acceleration analysis.

6) Complete (translational and rotational) mechanism inverse dynamics analysis via the Matrix Method.

7) Cam mechanism classification, cam motion profiles, introduction to cam design.

8) Gear mechanism classification, gear standardization and specification in design, plus gear train analysis.

9) Term project: complete kinematics and inverse dynamics analysis of a real-world mechanism. Done by teams of two students, all teams choose a unique mechanism. Must be presented orally to the class and in a written report.

ABET Competence Level Outcomes:

1-2.4i.A) The analysis of position, velocity, and acceleration kinematics of mechanisms.
1-2.4i.B) The analysis of inverse dynamics of mechanisms.

ABET Awareness Level Outcome:

1-2.4i.C) Basic analysis of cams and gears.

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Syllabus

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Textbook:

NONE!! (optional: **Design of Machinery: An Introduction to the Synthesis and Analysis of Mechanisms and Machines**, Norton, McGraw-Hill, 4th edition, 2008).

PDF Course Notes:

www.ent.ohiou.edu/~bobw; Courses Taught; ME 301 Course Notes

Notes fee: $30, due prior to the first quiz.

Week	***Topic***	***Notes***
1/5	Introduction, Matrices, Vectors, Matlab	1
1/12	Mobility, Position Analysis	1.5, 2.1
1/19	Position Analysis	2.1
1/26	Velocity Analysis	2.2
2/2	Acceleration and Jerk Analysis	2.3, 2.4
2/9	Review, Midterm 2/10, Input Motion Spec	2.5
2/16	Dynamics	3.1 – 3.3
2/23	Dynamics	3.4 – 3.7
3/2	Gears, Gear Trains	4
3/9	Cams, Review, Project Presentations	5

Final: Thursday, March 19, at 10:10 a.m., Comprehensive

ME 301 Kinematics & Dynamics of Machines

Policy

Time & Venue:

11:10 a.m. - 12 noon M T Th F 4 credit hours Stocker 190

Prerequisites:

C or better in ME 224

Description:

Analytical and graphical solutions of motion problems involving mechanical elements: linkages, gears, cams, and mechanical trains, etc.

Office Hours:

9:00 - 11:00 a.m. M F or by appointment
1:30 - 3:00 p.m. M

Homework:

Homework problems are assigned via e-mail on each Tuesday. The week's assignments will be collected on the following Tuesday at the start of class. The low homework grade will be dropped (ONLY IF YOU MAKE A GOOD-FAITH EFFORT TO COMPLETE THE FINAL ASSIGNMENT – see Homework Policy). A *MEMO* summarizing the week's assignments must be the first page of each submission.

Quizzes:

A short quiz will be given every Friday, covering the week's material. The low quiz grade will be dropped. All quizzes and exams are closed book and notes.

Project:

The term project is assigned here: www.ent.ohiou.edu/~bobw/PDF/Proj301.pdf; it is due 3/13/9. The project may be done in pairs or singly. One report will be submitted per team, both partners earn the same grade. The project will be evaluated via an interim midterm report, a final oral presentation, and a final formal technical report.

Academic Dishonesty:

Cheating in any form will not be tolerated. A grade of zero will be registered for any infraction, and the matter will be referred to the Director of University Judiciaries.

Attendance:

Attendance is required. No exam or quiz shall be made up without justifiable circumstances.

Grading:

Homework 20%	Quizzes 20%	Midterm 20%	Project 20%	Final Exam 20%

93.3-100	90-93.3	86.7-90	83.3-86.7	80-83.3	76.7-80	73.3-76.7	70-73.3	66.7-70	63.3-66.7	60-63.3	< 60
A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F

ME 301 Kinematics & Dynamics of Machines
Homework Policy
Dr. Bob

Homework problems are assigned via e-mail on each Tuesday. The week's assignments will be collected on the following Tuesday for detailed grading. The low homework grade will be dropped (ONLY IF YOU MAKE A GOOD-FAITH EFFORT TO COMPLETE THE FINAL ASSIGNMENT – if you do not turn in the last assignment or just give me a memo saying you want to drop the last one, you will get a zero for that last assignment that cannot be dropped and then you will also be unable to drop your other lowest HW score!). A *MEMO* summarizing the week's assignments must be the first page of each submission.

1) No late assignments will be accepted. Due: 11:10 a.m. on Tuesday.

2) No computer excuses will alter deadlines. In the event of problems, do your best.

3) Don't e-mail your HW to me or ask me to print it out.

4) Your work must be neat, with answers clearly noted and supporting information provided.

5) One complete hand calculation must be provided (if the computer is used to solve multiple problems) to verify your results.

Matlab Hints:

Use m-files (create via Matlab editor). Run Matlab and type the m-file name at the **>** prompt (if the file is **bob.m**, just type **bob**). Matlab will execute the commands in your m-file just as if you typed them one-by-one. A semi-colon **;** at the end of a line suppresses output so you don't have to see all intermediate variables. The on-line **help** function is very useful. Matlab plotting is easy and powerful (**help plot**). Use **who** to see what variables you have defined and **whos** to see your defined variables with array dimensions. Have fun and ask questions!

MEMO-WRITING. A MEMO MUST BE INCLUDED WITH YOUR HOMEWORK RESULTS EACH WEEK. An example memo is given on the next page. This should be a *brief* technical communication addressed to me, summarizing the week's homework assignments and bottom-line results. Your single memo must summarize all assignments each week. LENGTH LIMIT: *one single-sided page, 12 pt font*. Without a MEMO your HW score for the week will be entered as zero. If the MEMO is not clear, credit can also diminish.

OHIO UNIVERSITY

Russ College of Engineering & Technology
Department of Mechanical Engineering

DATE: January 1, 2009

TO: Dr. Bob Williams

FROM: Ima Student

SUBJECT: Homework Assignment #1

Dr. Bob,

The purpose of this memo is to present the basic results for HW Assignment #1. You assigned a total of two problems: (*enumerate briefly here*).

The answers to problem 1 are: (*give answers; not always appropriate here*). My sketches appear on p. 2 (*if appropriate*). I obtained the answers using Matlab file **`bob.m`**, which appears on p. 3. Sample calculations are presented on p. 4 to demonstrate that the computer code generates the correct results. (*Brief summary of roadblocks, issues, or learning here, if appropriate*).

For problem 2, (*similar to above paragraph*).

If you have any questions on my work, please contact me.

Sincerely,

Ima Student
almost_totally_unintelligible_username@ohio.edu