

UNIVERSITY OF CALIFORNIA  
Mechanical Engineering Department

**ME 130 - Design of Planar Machinery**

**Fall 2017**

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Instructor:	Dr. Ken Youssefi	<b>Office: 5106 Etcheverry Hall</b>
Class room:	60 Evans Hall	<b>Office hrs : TuTh 11:00 - 12:30</b>
Class time:	Lecture - TuTh 9:30 - 11:00	<b>phone: (510) 642-4483</b>
	Discussion/Lab – M 9-10 and W 11-12 (10 Jacobs)	<b><i>email: kyoussefi@aol.com</i></b>
Control #	39600	<b>Course website: bCourse</b>

**Final Exam: Group 10 – Wed. Dec. 13, 11:30 – 2:30 pm**

**GSI: Emily Lindberg**  
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**COURSE OBJECTIVE:**

Introduction to Mechanisms design and analysis. Graphical and analytical synthesis of mechanisms, path, motion, and function generation mechanisms. Complex polar notation and closed loop vector equations to analyze mechanisms. Position, velocity, acceleration and force analyses, cam design, static and dynamic balancing of mechanisms. The course will include a term project that involves the design, fabrication and prototype demonstration of a mechanical device.

**Required Text:** R. L. Norton, "Design of Machinery; an Introduction to Synthesis and Analysis of Mechanisms and Machines", 5<sup>th</sup> edition (2012), McGraw-Hill Inc.

**Group Design Project:** there will be a group design project. Refer to the design project handout for details.

**Homework:** homework problems will be assigned a week before the due date. Homework is due at the start of the lecture. Late homework will not be accepted. All graphical synthesis homework must be done using CAD.

**Grading: Homework (15%), Project (25%), Exam 1 (30%), Exam 2 (30%)**

**References:**

1. Journal of Mechanical Design, Transaction of ASME
2. G.H. Martin, Kinematics and Dynamics of Machine, McGraw-Hill
3. Shigley and Uicker, Theory of Machines and Mechanisms, McGraw-Hill
4. A.G. Erdman and G.N. Sander, Mechanism Design; Analysis and Synthesis, Prentice-Hall, V1,
5. A.H. Soni, Mechanism Synthesis and Analysis, McGraw-Hill
6. B. Paul, Kinematics and Dynamics of Planar Machinery, Prentice Hall
7. Beggs, J. S., Mechanism, McGraw-Hill, 1955, TJ175.B34 (WLN)
8. Hrones, J. A., Analysis of the Four-Bar Linkage; Its Application to Synthesis of Mechanism, MIT Technology, Press and J. Wiley, NY, 1951, TJ183.H7 (2 vol., WLN)

## COURSE SCHEDULE

Week/Date	Subject	Reading Assign.(ch.)	Homework Assign.
1	8/24 Introduction, Enrollment, Course organization, Design project discussion Introduction to mechanisms, Linkages.	(1)	Homework problems are due on Th. of the week indicated
2	8/29 Degree of freedom, Kinematics pairs 8/31 Design process - Synthesis vs. Analysis, Four-Bar mechanism, Mechanism classification, Transmission angle.	(2)	Design group formation
3	9/5 Mechanical advantage, Toggle positions 9/7 Graphical synthesis; Motion generation mechanism (two & three positions) Adding a Dyad to a mechanism (Grashof mechanism) Synthesis with fixed pivots. Animation using SolidWorks	(3)	Homework #1 due Th 9/7 DOF
4	9/12 Path generation mechanism (three positions), 9/14 Path generation mechanism synthesis with prescribed timing, Synthesis of a Quick-return mechanism, Design project discussion.	(3)	<b>Project proposal due 9/14</b> Homework #2 due Th 9/14 Graphical Synthesis (motion)
5	9/19 Analytical synthesis; Complex polar notation, Closed loop vector equation, 9/21 Motion generation mechanisms (two to five position), Design project discussion.	(4,5)	Homework #3 due Th 9/21 Graphical Synthesis (path)
6	9/26 Analytical synthesis; Function & path generation mechanisms, 9/28 Precision points, Chebychev spacing	(5)	<b>Design Review</b>
7	10/3 Example problems, Exam review (discussion period) <b>10/5</b>		<b>Exam 1, Thursday October 5</b>
8	10/10 Analytical analysis; Position, Velocity and Acceleration. 10/12 Position analysis-complex polar notation, Velocity analysis; Relative velocity, Graphical methods (velocity polygon, instant center), Analytical methods (complex polar notation) Motion analysis using SolidWorks	(4) (6)	<b>Project specification due 10/12</b> Homework #4 due Th. 10/12 Analytical synthesis (funct)
9	10/17 Acceleration analysis; Relative acceleration, 10/19 Graphical methods (acceleration polygon),	(7)	Homework #5 due Th. 10/19 Analytical analysis
10	10/24 Kinematics of gears an gear trains 10/26 Example problems, design project discussion.	(9 and lecture slides)	Homework #6 due Th. 10/26 Graphical analysis
11	10/31 Dynamic & static forces on mechanisms; Matrix method, 11/2 Graphical method, Torque requirements, Example problems.	(11)	<b>Design Review</b>
12	11/7 Cam design; Cam and follower type, Displacement diagram 11/9 Velocity and acceleration profiles	(8)	Homework #7 due Tu. 11/7 Force analysis
13	11/14 High speed cam design (example problem), Exam review 11/16		<b>Exam 2, Thursday Nov. 16</b>
14	11/21 Balancing; Static and dynamic, four-bar mechanism <b>11/23 Holiday – Thanksgiving</b>	(12)	
15	11/28 Design project presentations and prototype demonstration, groups 11/30 Design project presentations and prototype demonstration, groups	1 – 5 6 – 10	
16	12/5 Design project presentations and prototype demonstration, groups 12/7 <b>Mechanism Expo - Thursday December 7, 11:00 – 1:00 room 3110 Etcheverry</b> <b>Final project report is due at the Expo</b>	11 – 16	RRR week