UNIVERSITY OF CALIFORNIA
Mechanical Engineering Department

**ME 130 - Design of Planar Machinery** **Fall 2016**


Instructor: Dr. Ken Youssefi **Office: 5106 Etcheverry Hall**
Class room: 60 Evans Hall **Office hrs : TuTh 11:00 - 12:30**
Class time: Lecture - TuTh 9:30 - 11:00 **phone: (510) 642-4483**
Discussion/Lab – M 9-10 and W 11-12 (10 Jacobs) ***email: kyoussefi@aol.com***
Control # 28269 **Course website**: **bCourse**

**Final Exam: Group 7 – Tuesday Dec. 13, 3:00 – 6:00 pm** **GSI: Anju Toor**
***email: atoor@berkeley.edu***


**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", 5th 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 10%, Project 25%, Two Midterm Exams 20% each, Final Exam 25%**

**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 | 8/25 | Introduction, Enrollment, Course organization, Design project discussion Introduction to mechanisms, Linkages. | (1) | Homework problems are due on Th. of the week indicated |
| 2 | 8/30<br>9/1 | Degree of freedom, Kinematics pairs<br>Design process - Synthesis vs. Analysis, Four-Bar mechanism, Mechanism classification, Transmission angle. | (2) | Design group formation |
| 3 | 9/6<br>9/8 | Mechanical advantage, Toggle positions<br>Graphical synthesis; Motion generation mechanism (two & three positions) Adding a Dyad to a mechanism (Grashof mechanism) Synthesis with fixed pivots. | (3) | Homework #1 due Th 9/8 |
| 4 | 9/13<br>9/15 | Path generation mechanism (three positions),<br>Path generation mechanism synthesis with prescribed timing, Synthesis of a Quick-return mechanism, Design project discussion. | (3) | Homework #2 due Th 9/15 |
| 5 | 9/20<br>9/22 | Analytical synthesis; Complex polar notation, Closed loop vector equation,<br>Motion generation mechanisms (two to five position), Design project discussion. | (4,5) | Homework #3 due Th 9/22 |
| 6 | 9/27<br>9/29 | Analytical synthesis; Function & path generation mechanisms,<br>Precision points, Chebychev spacing | (5) | **1st Design Review** |
| 7 | 10/4<br>**10/6** | Example problems, Exam review (discussion period)<br>***Exam 1, Thursday October 6*** | | |
| 8 | 10/11<br>10/13 | Analytical analysis; Position, Velocity and Acceleration.<br>Position analysis-complex polar notation,<br>Velocity analysis; Relative velocity, Graphical methods (velocity polygon, instant center), Analytical methods (complex polar notation). | (4)<br>(6) | |
| 9 | 10/18<br>10/20 | Acceleration analysis; Relative acceleration, Graphical methods (acceleration polygon), | (7) | Homework #4 due Tu 10/18 |
| 10 | 10/25<br>10/27 | Kinematics of gears an gear trains<br>Example problems, design project discussion. | (9 and lecture slides) | Homework #5 due Tu 10/25 |
| 11 | 11/1<br>11/3 | Dynamic & static forces on mechanisms; Matrix method, Graphical method, Torque requirements, Example problems. | (11) | Homework #6 due Tu. 11/1 |
| 12 | 11/8<br>11/10 | Cam design; Cam and follower type, Displacement diagram<br>Velocity and acceleration profiles | (8) | Homework #7 due Th 11/10 |
| 13 | 11/15<br>11/17 | High speed cam design (example problem), Exam review<br>***Exam 2, Thursday Nov. 17*** | | |
| 14 | **11/22**<br>**11/23-25** | Balancing; Static and dynamic, four-bar mechanism<br>***Holiday – Thanksgiving*** | (12) | |
| 15 | 11/29<br>12/1 | Design project presentations and prototype demonstration, groups 1 – 5<br>Design project presentations and prototype demonstration, groups 6 – 10 | | |
| 16 | 12/6<br>12/8 | Design project presentations and prototype demonstration, groups 11 – 16<br>***Mechanism Expo - Thursday December 8, 11:00 – 1:00 room 3110 Etcheverry***<br>**Final project report is due at the Expo** | | RRR week |

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