

# ME 6230 Kinematics and Mechanisms

## Winter 2021, CRN 12086, TR 7:30 ~ 9:17, **ONLINE – asynchronous**

**Designation :** A technical elective for **ME** graduate students.  
One of core requirements for **ECE** “Master of Science in Mechatronics Program.”  
(Prof. Chang does NOT allow undergraduate students in this class.)

### **Course Description – CATALOG DATA**

#### **ME 6230 Kinematics and Mechanisms (4 credits)**

Advanced kinematics analysis & synthesis, and mechanism design. DOF (Degrees Of Freedom) of Mechanisms and equivalent linkages. Analyze/Synthesize linkage positions, velocities and accelerations. Cam/follower systems, gears and gear trains analyses.

**Offered:** winter semester.

**Instructor :** Yin-ping (Daniel) Chang  
Associate Professor  
Engineering Center 418  
Tel : 248-370-2209  
Fax : 248-370-4416  
Email: [ychang@oakland.edu](mailto:ychang@oakland.edu)  
Webpage: [www.secs.oakland.edu/~ychang/](http://www.secs.oakland.edu/~ychang/)  
Office hours : email by appointment, online

**Textbook :** *Design of Machinery*, 6<sup>th</sup> ed., Norton, Robert L., McGraw-Hill.  
Lecture notes, ASME & MMT journal & conference papers, SAE technical papers.

**HW Policy :** The HW is due at the beginning of the class on the due date. HW solutions will be provided and discussed on due dates. **NO LATE HW WILL BE ACCEPTED!**

**Exam and Grading Policy :** The final course grade will be a weighted average of :

HW (3 ~ 4 assignments)	25 %	HW	33.33 %
Mid-term Exam #1	25 %	Mid-term Exam	33.33 %
Mid-term Exam #2	25 %	Final Project	33.33 %
Final Project	25 %		

A>90, B>80, C>70, D>60, F=<60. Any questions about the grading should be addressed to the professor, within one week after it's been returned.

**Objectives :** By the end of the course, the successful student will be able to:

1. Analyze linkages to determine DOF (Degrees Of Freedom) and equivalent linkages.
2. Analyze/Synthesize linkage positions, velocities and accelerations using graphical & analytical approaches, and implement the algorithm in a computer program.
3. Analyze various types of gears and gear trains.
4. Analyze cam/follower systems.

**Academic Conduct :** Students are expected to read, understand, and comply with the "Academic Conduct Policy" as explained in Oakland University Graduate catalog. Violations will be taken before the Academic Conduct Committee. Students found guilty of academic misconduct in this course will receive a grade of 0.0 in addition to any penalties imposed by the Academic Conduct Committee.

## TENTATIVE LECTURE and EXAM SCHEDULE

*The schedule below is to be used as a guideline. There might be some deviation and it is the student's responsibility to be aware of any changes that are announced in class. ~~The early morning or evening lectures/exams are possible.~~  
(25 ~ 27 lectures approximately.)*

<u>Lecture Topics</u>	<u>Materials</u>	<u>Exams</u>
x. Mechanisms and Kinematics Fundamentals (*1)	Ch. 1	
I. Mobility Analysis – DOF (*6)	2.0 ~ 2.6 & 2.8 & 2.10 ~ 2.13	
➤ DOF (Mobility) – Gruebler's Eq.		
➤ Grashof Criteria		
➤ Mechanism types		
➤ Mechanism tasks		
II. Number synthesis & Isomer	2.7 & 2.9	
➤ 5-equations model		
➤ Franke's Molecule Technique		
III. Transmission angles & Toggle positions (*2)	3.3 & 4.11 & 4.12	
<b>Mid-term Exam#1</b>		
IV. Fundamental kinematics analysis of linkages		
➤ Position and displacement analysis (*2)	Ch. 4	
- Vector loop equation – Freudenstein Equation		
➤ Velocity analysis	Ch. 6	
- Differentiation of vector loop equation – Complex-vector analysis		
➤ Acceleration analysis		
- Complex-vector analysis	(Ch. 7 reference materials)	
V. Instant Centers Analysis		
➤ Finding Instant Centers of different types of linkages ( <u>determinate &amp; indeterminate</u> )		
➤ Velocity analysis by instant center approach (*3)	6.3 & 6.4	
x. Quick return mechanisms (*2)	3.0 ~ 3.2 & 3.4 & 3.5	
x. Graphical & analytical linkage synthesis	Ch. 3 & (Ch. 5 reference materials)	
<b>Mid-term Exam#2</b>		
VI. Gears (*5)	Ch. 9	
➤ Terminology and types of gears		
➤ Analyze gears and gear trains – angular velocity ratio (Lever Analogy)		
➤ Fundamental laws of gearing	(reference materials)	

**Final Project & Presentation on 4/13 & 4/15 7:30 ~ 9:17pm or 4/22 7 ~ 10pm**

**CLASS ATTENDANCE IS STRONGLY RECOMMENDED**

**Academic Conduct :** Students are encouraged to discuss HW assignments in studying groups, **BUT everybody will need to work on the HW and turn in individual work.** Students are also expected to read, understand, and comply with the "Academic Conduct Policy" as explained in Oakland University Graduate catalogs. If you cheat, you are not only hurting yourself, but also taking unfair advantage of the other students in the class. Violations and suspicions of cheating or plagiarism will be brought to the attention of the Academic Conduct Committee (ACC) for investigation. **Students found guilty of academic misconduct in this course will receive a grade of F (0.0) in addition to the sanction imposed by ACC.**

**Prepared by / Date Prepared :**

Prof. Yin-ping Chang / January 7, 2021