

ME 6230 Kinematics and Mechanisms

Winter 2018, CRN 12750, TR 7:30 ~ 9:17, DH 237

Designation : A technical elective for ME graduate students.
One of core requirements for ECE “Master of Science in Mechatronics Program.”

Course Description – CATALOG DATA

ME 530 Kinematics and Mechanisms (4 credits)

Advanced kinematics analysis, synthesis and mechanism design. Mechanisms’ degrees of freedom and equivalent linkages analyses. Isomer structure number synthesis. Analyze/Synthesize linkage positions, velocities and accelerations using graphical and analytical approaches. Analyze/Synthesize linkage geometry and construction. Various types of gears and gear trains analysis. (Offered winter.)

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Office hours : TR 6:30 ~ 7:20 and after the class. (or by appointment.)

Textbook : *Design of Machinery*, 5th ed., Norton, Robert L., McGraw-Hill.
Lecture notes, ASME & MMT journal & conference papers, SAE technical papers.

Prerequisites : Machine Dynamics, Kinematics and Mechanisms, or equivalent undergraduate courses.

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!** Any questions about the grading should be addressed to the professor, within one week after it’s been returned.

Exam and Grading Policy : The final course grade will be calculated as follows:

HW (4 assignments)	33.33 %
Mid-term Exams (2)	33.33 %
Final Project	33.33 %

The Grading scales: >92--4, >80--3, >68--2, >56--1, =<50--0. Again, 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. Determine DOF (Degrees Of Freedom) of mechanisms and equivalent linkages.
2. Complete isomer number synthesis of a specific mechanism.
3. Define maximum and minimum transmission angles of different types of mechanisms.
4. Decide toggle positions of different types of mechanisms.
5. Analyze mechanism’s type and task.
6. Identify Quick Return mechanisms and calculate the Quick Return Ratio (Time Ratio).
7. Formulate Closure Loop equations by Freudenstein’s approach.
8. Apply Kennedy’s Theorem to locate instant centers of linkages.
9. Calculate linkage’s coupler points’ velocities by instant center approach.
10. Analyze gear trains structures.
11. Calculate gear ratios of various types of gear trains.

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>
I. Kinematics & Mechanisms introduction	Ch. 1	
II. Mechanisms and kinematics fundamentals <ul style="list-style-type: none">➤ DOF (or Mobility) – Gruebler's Eq.➤ Number synthesis – isomers➤ Grashof criteria	2.1 ~ 2.13	
III. Toggle positions & Transmission angles	3.3 & 4.11 & 4.12	
Mid-term Exam#1		
IV. Kinematic analysis of linkages <ul style="list-style-type: none">➤ Position and displacement analysis - Vector loop equation – Freudenstein Equation➤ Velocity analysis - Complex-vector analysis – Differentiation of vector loop equations➤ Acceleration analysis - Complex-vector analysis	Ch. 4 Ch. 6 (Ch. 7 reference materials)	
V. Finding Instant Centers of different types of linkages (<i>determinate & indeterminate</i>) Velocity analysis by instant center approach	6.3 & 6.4	
VI. Quick return mechanisms	3.0 ~ 3.2 & 3.4 & 3.5	
VII. Graphical & analytical linkage synthesis	Ch. 3 & (Ch. 5 reference materials)	
Mid-term Exam#2		
VIII. Analyze gears and gear trains (*5) <ul style="list-style-type: none">➤ Terminology and types of gears➤ Gear trains – angular velocity ratio (<i>Lever Analogy</i>)➤ Fundamental laws of gearing	Ch. 9 (reference materials)	
Final Project & Presentation		

CLASS ATTENDANCE IS STRONGLY RECOMMENDED

Academic Conduct : Students are encouraged to discuss HW assignments in a studying group, BUT everyone NEEDS to turn in individual work; and are expected to read, understand, and comply with the "Academic Conduct Policy" as explained in Oakland University Undergraduate and 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 0.0 in addition to the sanction imposed by ACC.

It is required that all cell phone be put on silent or vibration during the class sessions. If you need to take a phone call, please excuse yourself quietly out of the classroom and take the call in the hallway.

Laptops/iPads are allowed in the class session for taking notes or presenting information to the class. Emailing, working on assignments or viewing sites unrelated to the course are prohibited.