ORTA DOĞU TEKNİK ÜNİVERSİTESİ
MIDDLE EAST TECHNICAL UNIVERSITY

ME 301
Theory of Machines I

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1. Introduction and Basic Concepts

Introduction and Application Examples

Definitions

Degree of Freedom

    Kutzbach Formula

    General Equation

    Exceptions

Grübler's Equation

Kinematic Inversion

Enumeration

Basic Definitions

Machine: A self contained assembly of components that transmits / modifies energy to perform or assist a specific task.

- It has an energy source (input / prime mover / motor)

- It accomplishes a well defined task (output / work)

(Mechanical) Machine: Mechanical forces of nature, accompanied by motion, are compelled to do the work (task).
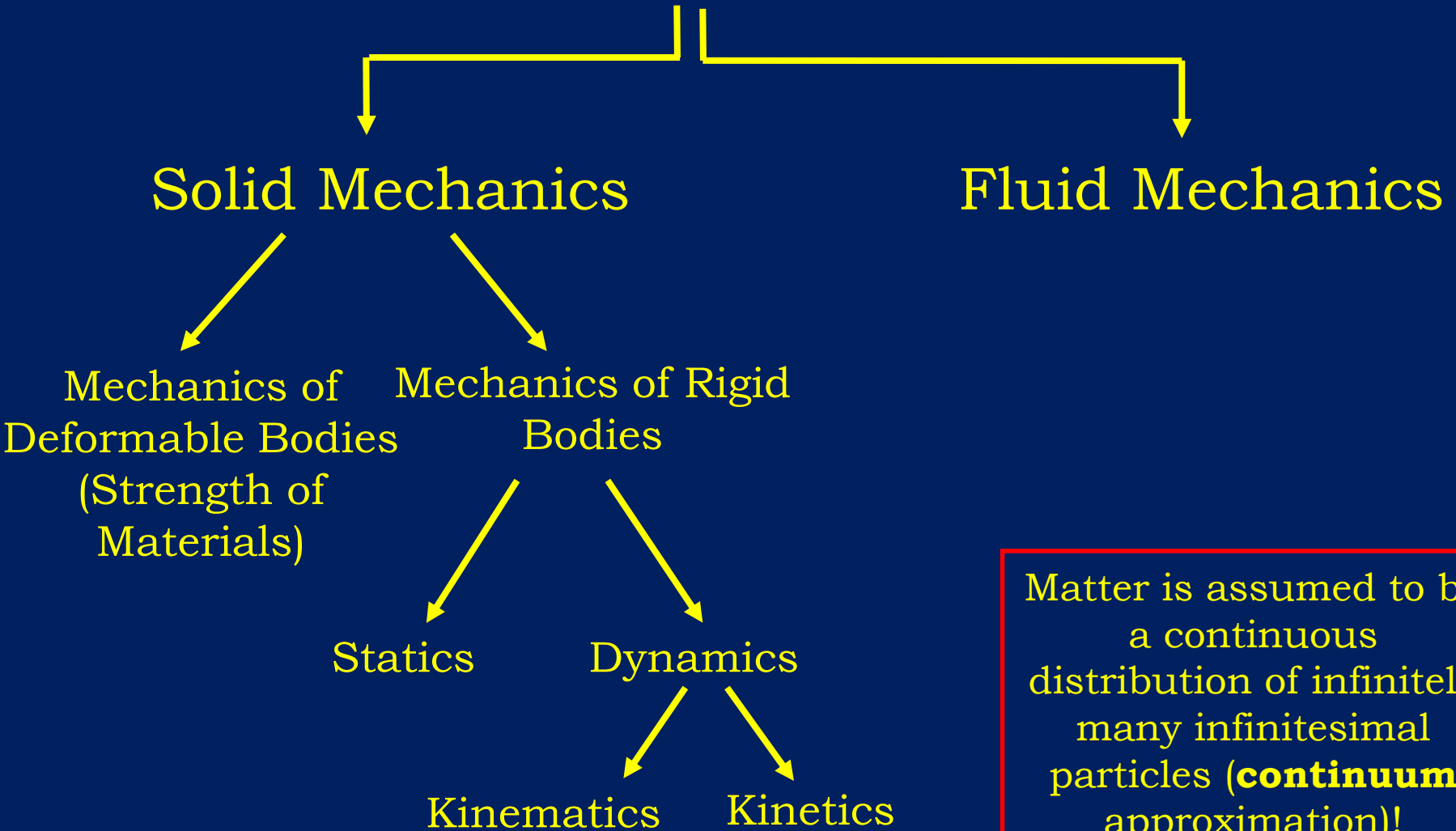
Theory of Machines: An applied science used to understand / generate motions of parts of the machine and the forces that produce / accompany these motions.

Various Phases of Machine Design

- Satisfying motion transmission requirements

- Calculation of driving force(s) and accompanying reactions (internal forces)

  ME 301

- Satisfying dynamic requirements (smooth operation, control of vibration, noise)

  ME 302

- Satisfying strength and rigidity requirements

  ME 307-8

- Satisfying economic, ergonomic, esthetic, safety requirements

  ME 407

Mechanics

concerned with the behavior of bodies/matter under the action of forces

Solid Mechanics

Fluid Mechanics

Mechanics of Deformable Bodies (Strength of Materials)

Mechanics of Rigid Bodies

Statics

Dynamics

Kinematics

Kinetics

Matter is assumed to be a continuous distribution of infinitely many infinitesimal particles (**continuum** approximation)!

Definitions

Kinematics of machinery deals with the motion transmission characteristics in isolation from forces. Also named as *Mechanisms.*

Mechanism is a group of rigid bodies (**links**) connected to each other by rigid joints (**kinematic pairs**) having the purpose of motion transmission.

Link: A rigid body (a body that does not change its shape and size under the action forces (**an idealization!**) that has rigid kinematic elements.

Kinematic Pair / Joint: Two or more kinematic elements joining two or more links permitting certain relative motion between the links, (unlike the '*joint*' in ME 307 Machine Elements!)
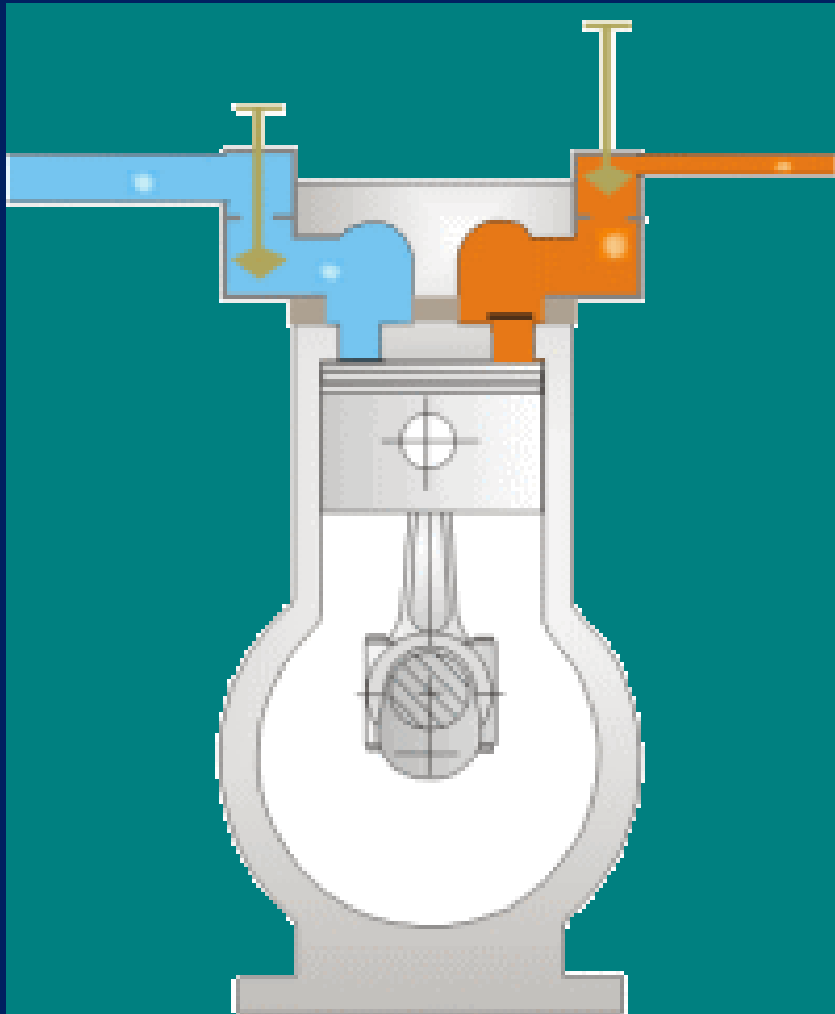
Mechanism

- It is a group of rigid bodies (*links*) connected to each other by rigid kinematic pairs (*joints*) to transmit force and motion.

- It is a kinematic chain where **one of the links is fixed**.

- A mechanical machine is defined as a combination of resistant bodies so arranged that by their means the mechanical forces of nature can be compelled to do work accompanied by certain determinate motion[1].

Mechanisms are the basic building blocks of mechanical machines. A machine is designed for a specific task using appropriate mechanisms.
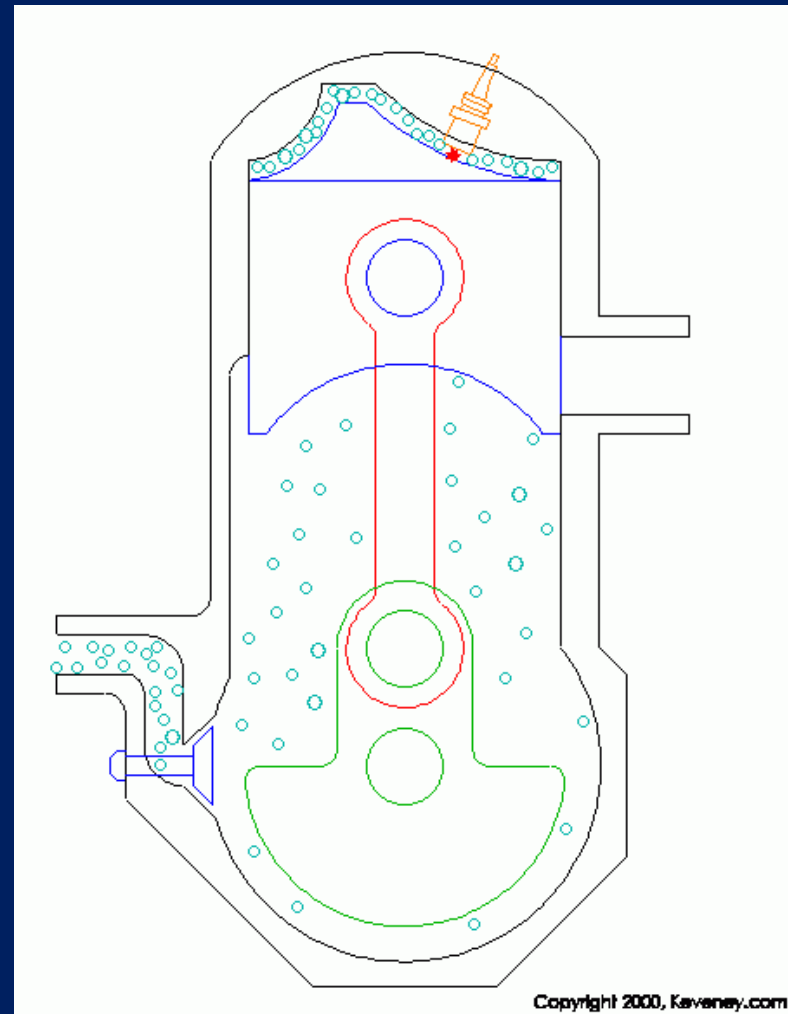
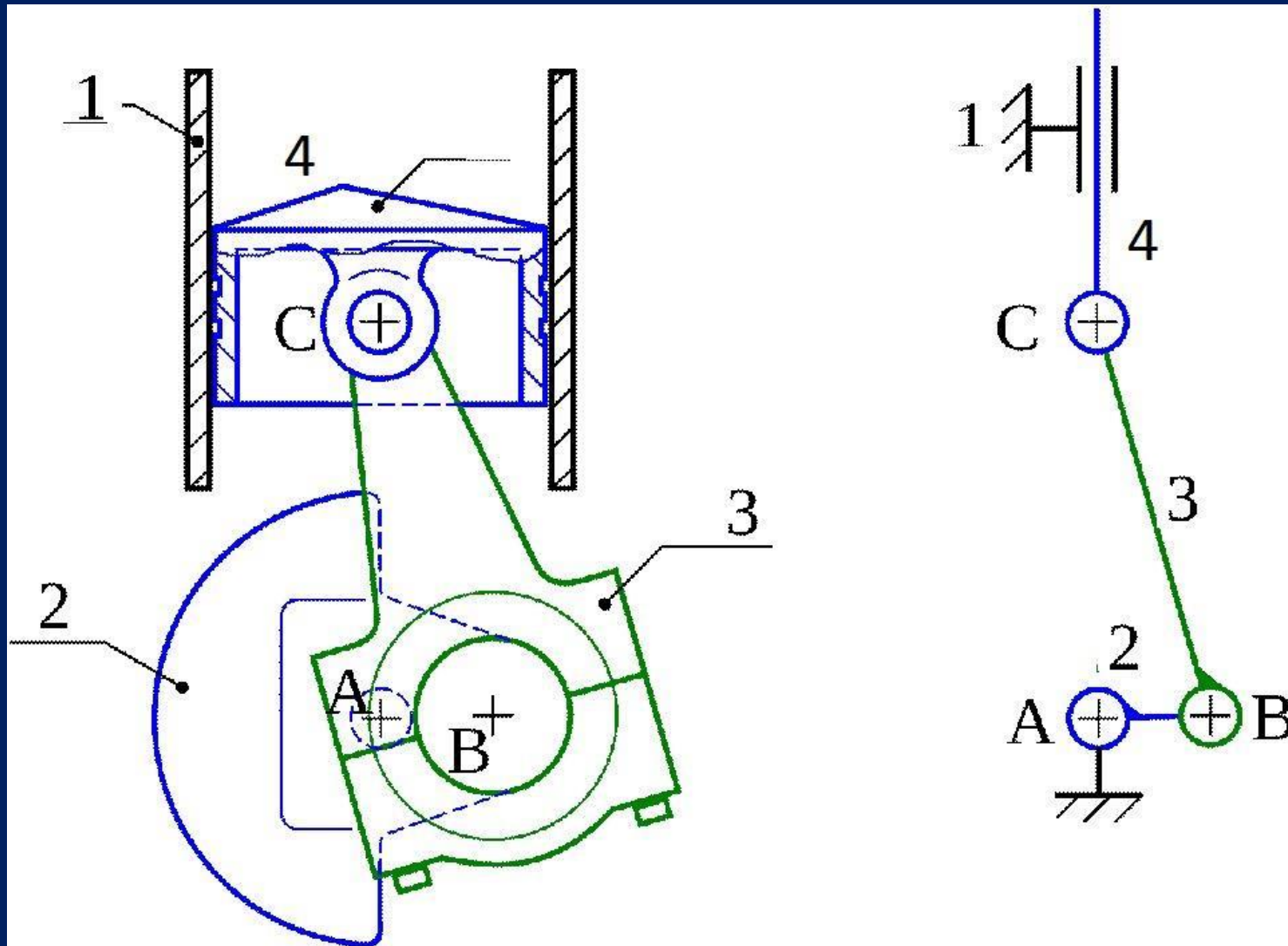[1] Reulaeaux, Kinematics of Machinery, 1876

Examples

Reciprocating Air Compressor

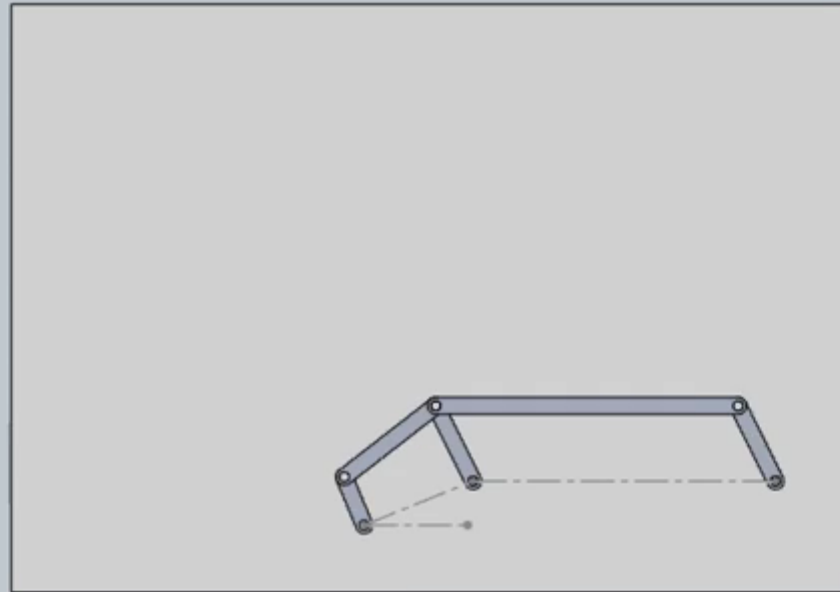## Two-Stroke Internal Combustion Engine

Copyright 2000, Keveney.com

Examples

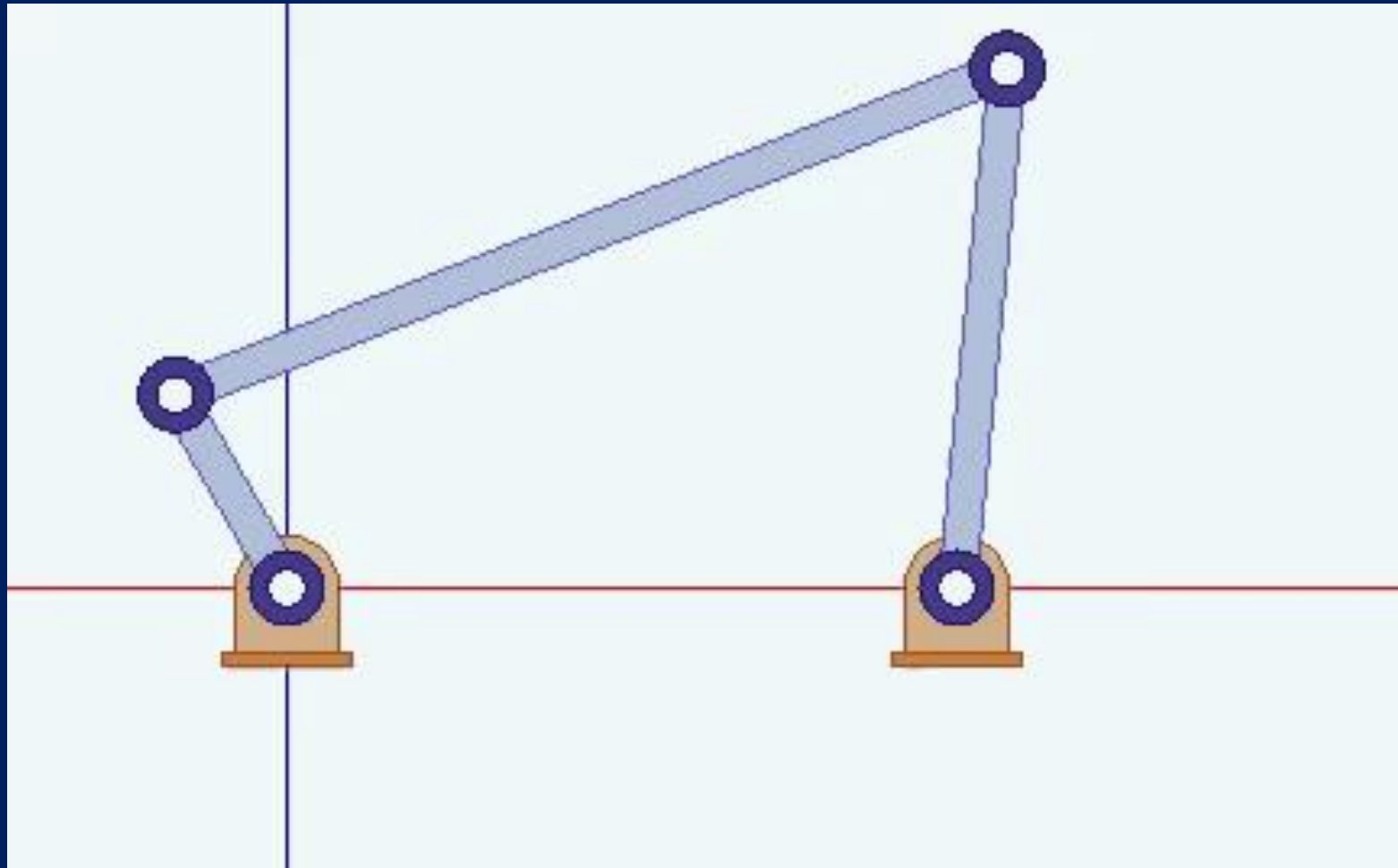Slider-crank mechanism   Kinematic Diagram

Examples

Windshield Wiper

Examples

Crank-Rocker Four Bar Mechanism

Examples

Physical Examples of Instructor
Six short asynchronous lectures.

Examples in the textbook pp. 5-9

https://ocw.metu.edu.tr/mod/resource/view.php?id=2095
https://ocw.metu.edu.tr/pluginfile.php/3958/mod_resource/content/19/ch1/1-2_2.htm
https://ocw.metu.edu.tr/pluginfile.php/3958/mod_resource/content/19/ch1/1-2_3.htm
https://ocw.metu.edu.tr/pluginfile.php/3958/mod_resource/content/19/ch1/1-2_4.htm
https://ocw.metu.edu.tr/pluginfile.php/3958/mod_resource/content/19/ch1/1-2_5.htm

Similar to above but in Turkish

http://makted.org.tr/wp-content/uploads/kaynaklar/ders_sunumlari/1.IntroductionToMechanisms.pdf

Slides 15-21, 24-28, 43

http://makted.org.tr/wp-content/uploads/kaynaklar/mekanizma_teknigi_konu_anlatimi/ch1/1-2_1.htm
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