MAE 342
Dynamics of Machines

Introduction to Mechanism Analysis
Typical problem

- Given piston-connecting rod-crank shown, with engine rotating at 4000 RPM, what is:
  a) Piston displacement between BDC and TDC?
  b) Maximum piston velocity?
  c) Maximum piston acceleration?

- A – 3 inches
  B – 2 inches
  C – 5 inches

- Why is it important to know these values?
What is “Kinematics”?  

- Let’s start at the beginning  
- Mechanics is:  
  “That branch of scientific analysis that deals with motions, time, and forces.”
What is “Kinematics”?

- **Kinematics**
  - “Is the study of motion, apart from the forces which produce the motion.”
  - The motion is totally dependent on:
    - the linkage geometry and
    - specified positions, velocities, and accelerations.
  - Bodies are assumed to be rigid.

- **Kinetics is:**
  - “Is the study of motion, and forces producing the motion.”
  - The motion depends on:
    - the linkage geometry and mass properties
    - forces on the linkage.
What is “Kinematics”?

- A **machine** is “a combination of resistant bodies designed to **do work** by virtue of their motions.”

- A **mechanism** is “a combination of resistant bodies designed to **transform motion** by virtue of being connected by movable **joints**.”
Types of Joints

- **Lower pairs** have surface contact between bodies.

- **Higher pairs** have point or line contact.
Types of Joints

Figures from Uicker et al., *Theory of Machines and Mechanisms*

Figure from Unigraphics on-line documentation.
Analysis versus Synthesis

• Mechanism **analysis** is “computing or in some way determining the motion of a prescribed mechanism.”

• Mechanism **synthesis** is “conceiving or in some way identifying a mechanism that can give a prescribed motion.”