

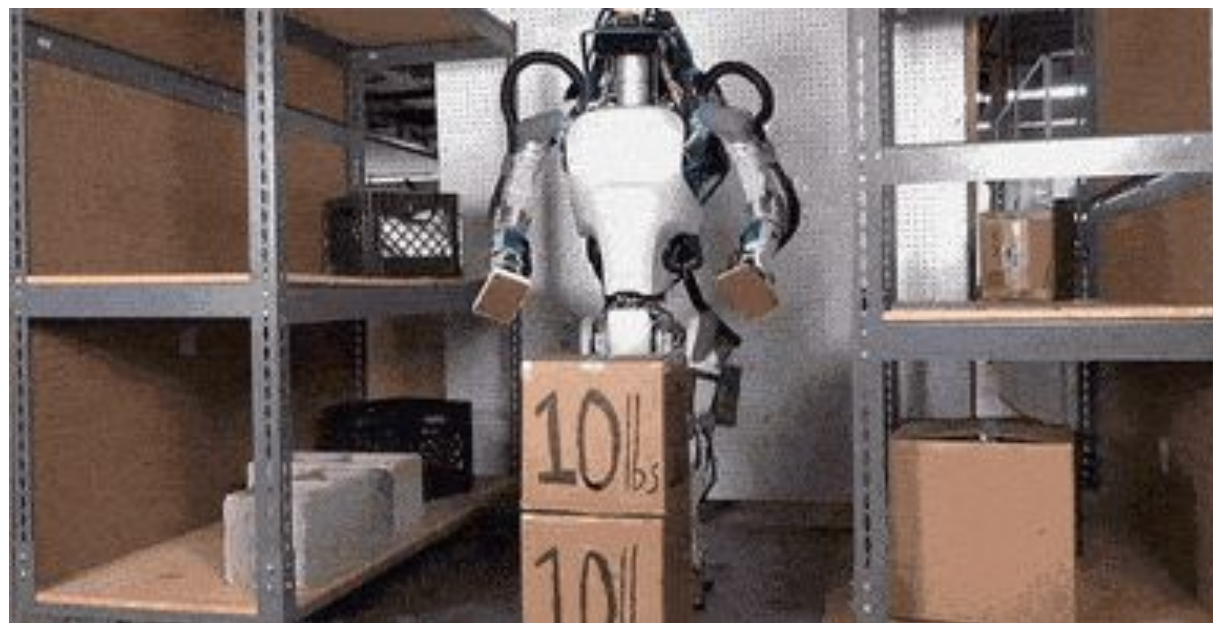
Introduction to Robotics

Lecture 1

What is a Robot?

What is a Robot?

- Complex Machine
- Decreases human effort.
- Speed and Precision
- Multitasking





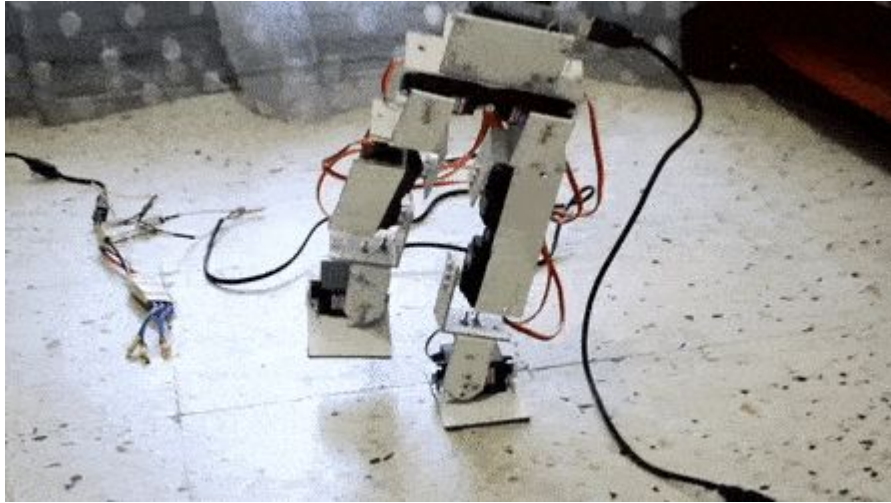


Types of Robots

Based on Mechanical Structure -

- Legged
- Wheeled
- Stationary (Manipulators)
- Flying
- Swimming
- Others

Legged Robots

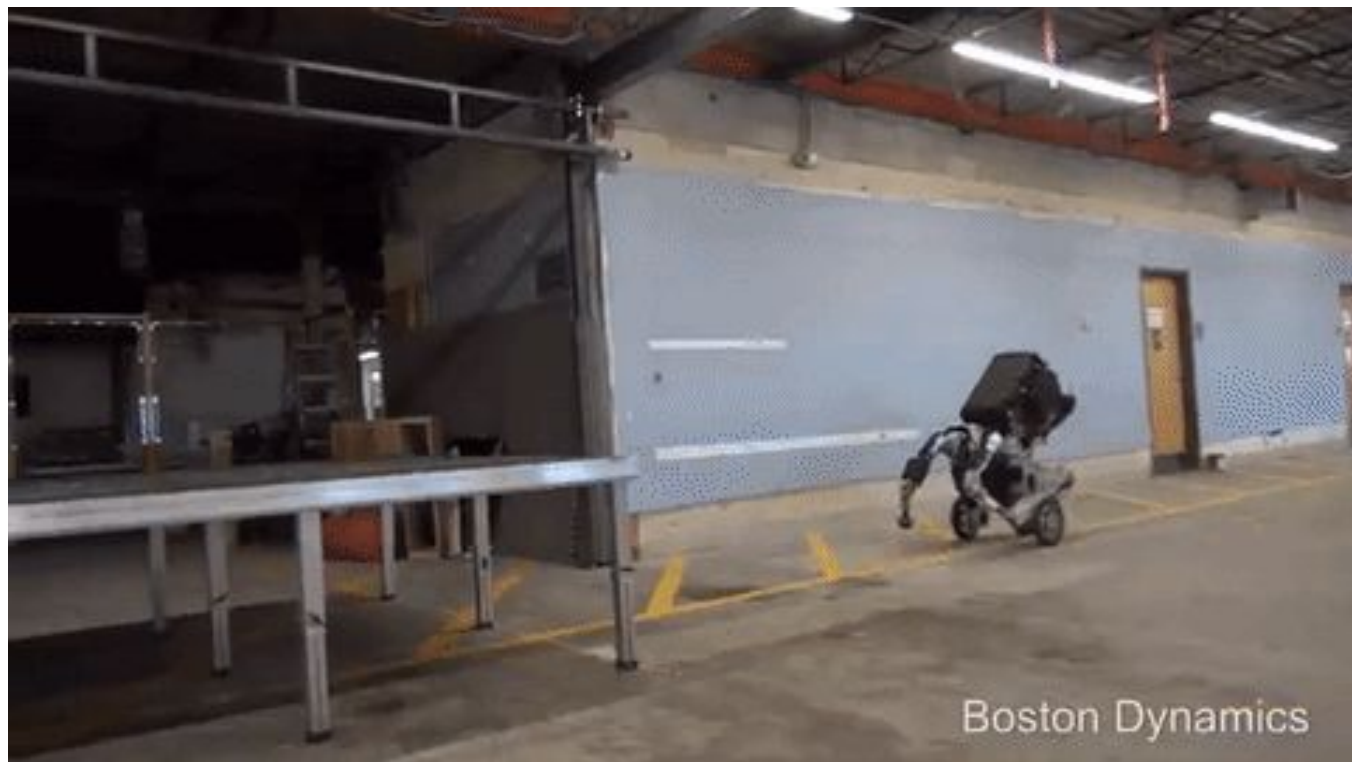


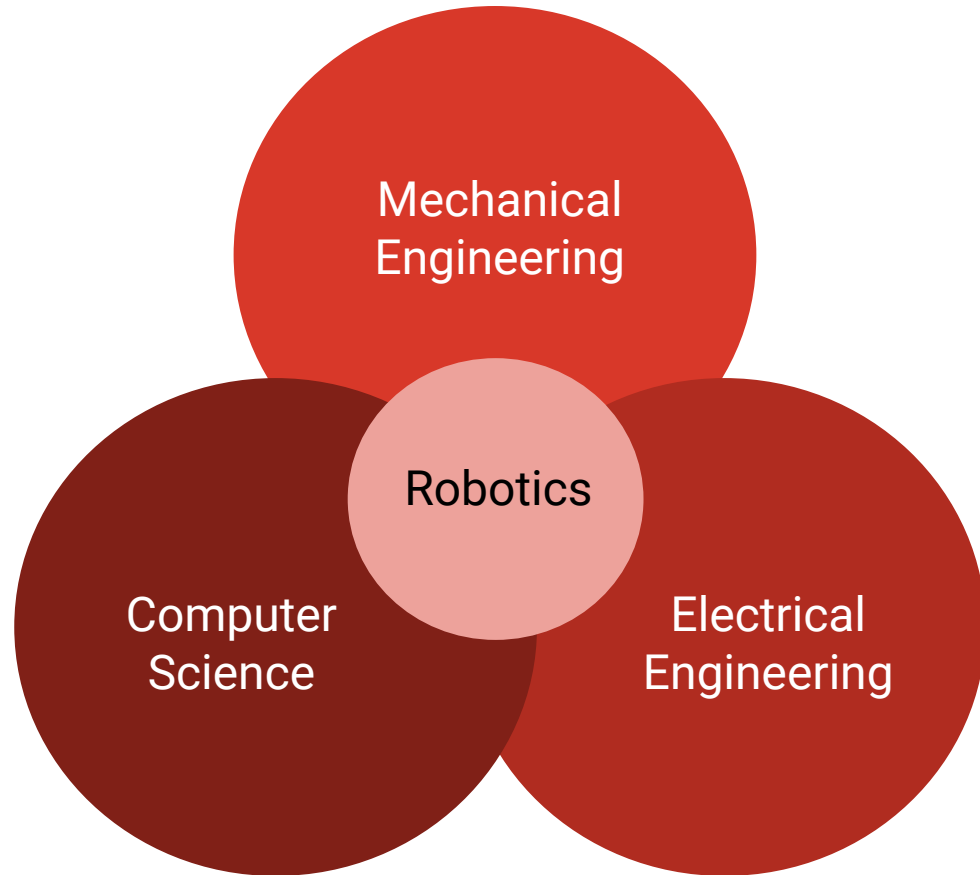
Wheeled Robots

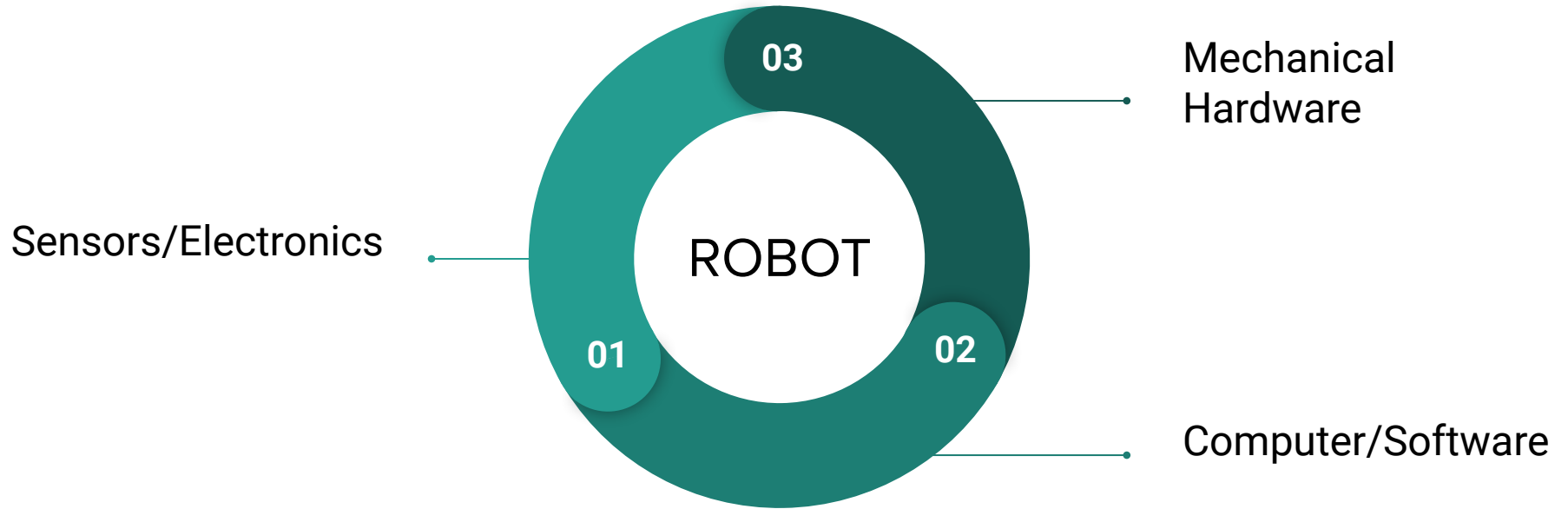


Manipulators









Mechanical Systems



Steps...

1. Identification of Problem Statement
2. Design and Calculations of the parts to be made
3. Manufacturing of Parts
4. Selection of Mechanical Components
5. Final Assembly
6. Testing
7. Repeat

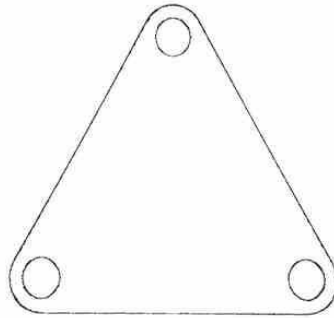
Basic Terminology

- Joint - A part of machine which is used to join 2 or more parts of the machine.
- Link - A link is a rigid body which contains at least 2 end to join other links
- Linkage - Assembly of links and joints that provide a desired output in response to a specific input motion.
- Structure- An arrangement of links with no relative motion.
- Kinematic Pair - An arrangement of links with relative motion.
- Kinematic Chain - When kinematic pairs form a chain to transmit definite motion.
- Mechanism- A kinematic chain in which at least one link is connected to a frame of reference.
- Machine - An assemblage of parts that transmit forces, motion and energy in a predetermined manner.

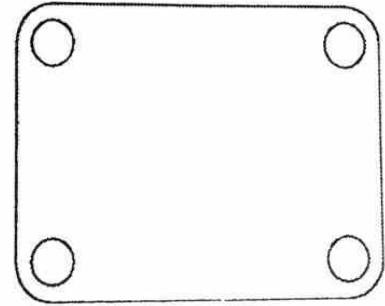
Types of Links - Rigid Links



Binary link

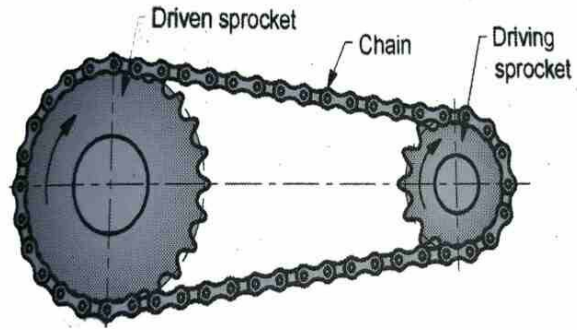


Ternary link

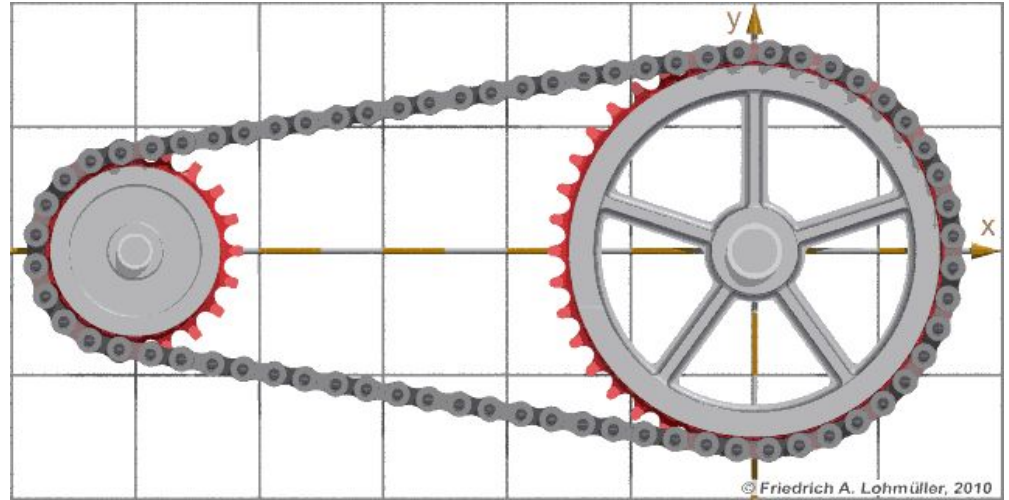


Quaternary link

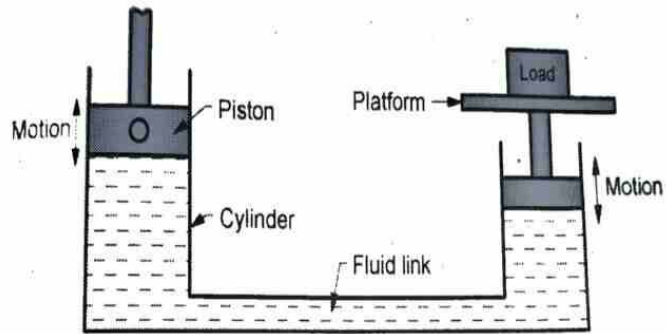
Types of Links - Flexible Links



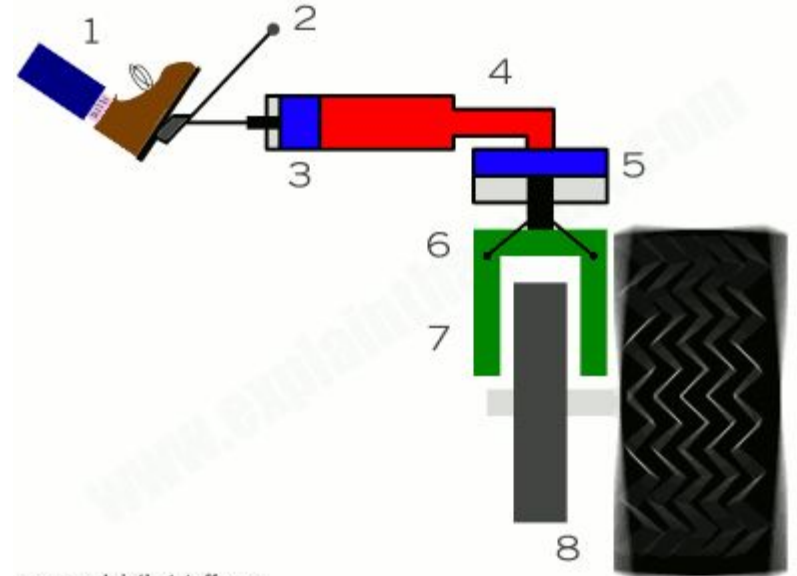
Flexible link



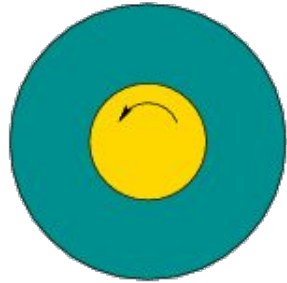
Types of Links - Fluid Links



Fluid link

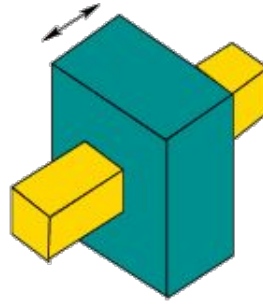


Types of Kinematic Pairs - Lower Pairs



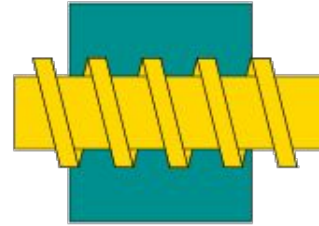
Revolute

1 Degree of Freedom



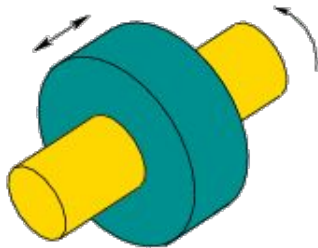
Prismatic

1 Degree of Freedom



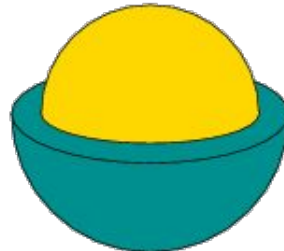
Screw

1 Degree of Freedom



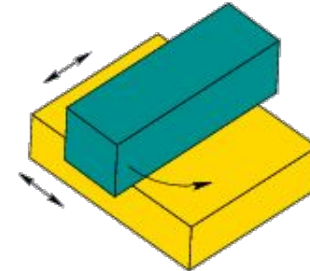
Cylindrical

2 Degrees of Freedom



Spherical

3 Degrees of Freedom



Planar

3 Degrees of Freedom

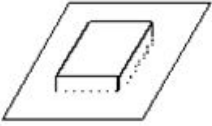
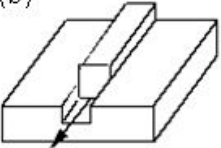
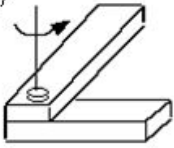



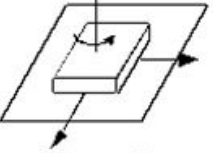
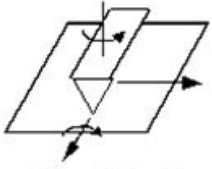
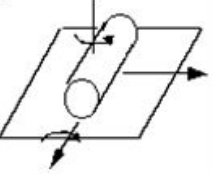
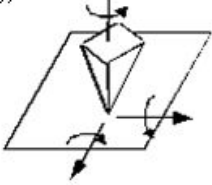
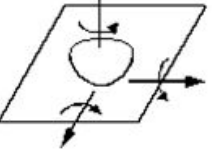
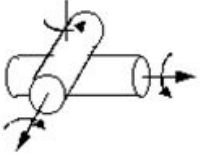
Types of Kinematic Pairs - Higher Pairs

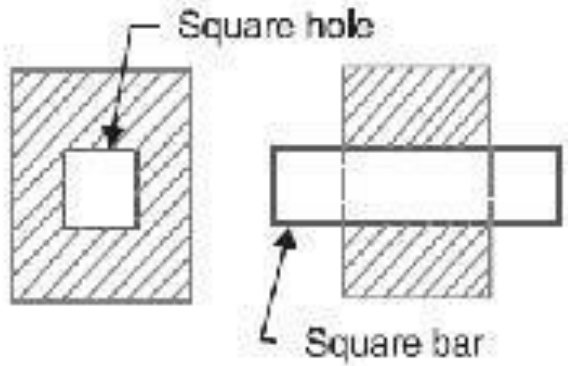
- Line Contact Pair
- Point Contact Pair

Degrees of Freedom

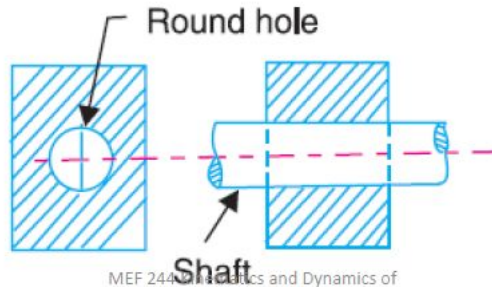
It is the number of independent coordinates required to describe the position of a body in space.

A free body in space has 6 degrees of freedom

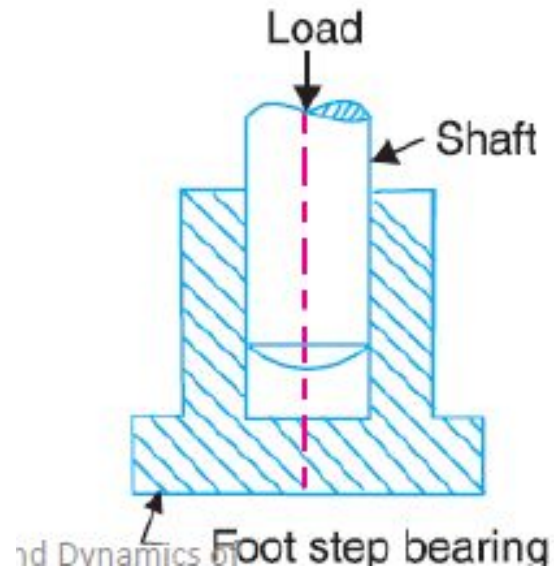
(a)  Rigid (no motion)	(b)  Prismatic (1)	(c)  Revolute (1)	(d)  Parallel Cylinders (2)
(e)  Cylindrical (2)	(f)  Spherical (3)	(g)  Planar (3)	(h)  Edge Slider (4)
(i)  Cylindrical Slider (4)	(j)  Point Slider (5)	(k)  Spherical Slider (5)	(l)  Crossed Cylinders (5)



Completely Constrained Motion



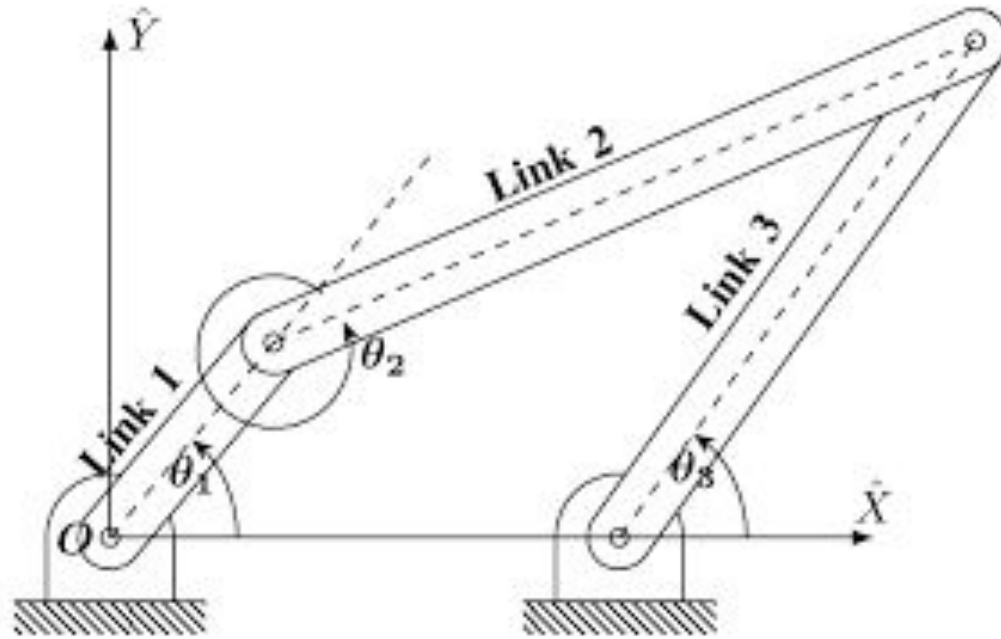
Incompletely Constrained Motion



Successfully Constrained Motion

Mechanisms

Kinematic Chain

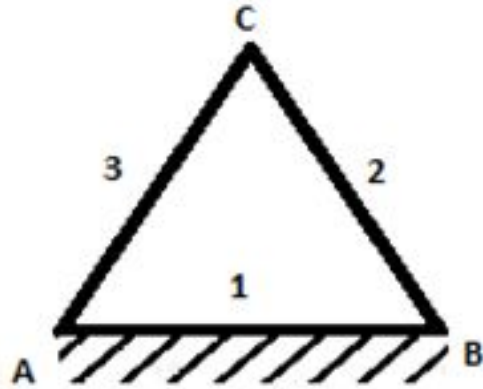


Kutzbach Mobility Criterion

- Kutzbach Criteria is for determining Degree of Freedom of body in Planar Mechanism (2D)

$$\text{DOF} = 3(L-1) - 2J - H$$

- Here:
- L = Number of Link
- J = Number Of Lower Pair
- H = Number Of Higher Pair

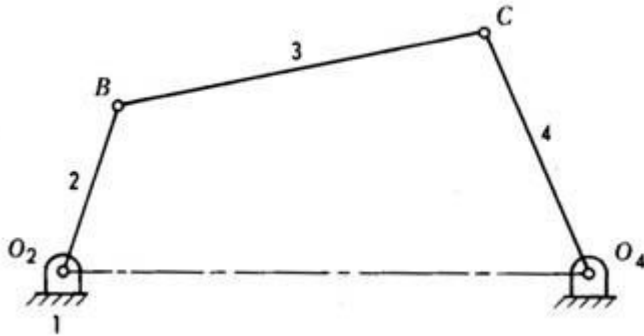


$$L = 3$$

$$J = 3$$

$$H = 0$$

$$\text{DOF} = 0$$

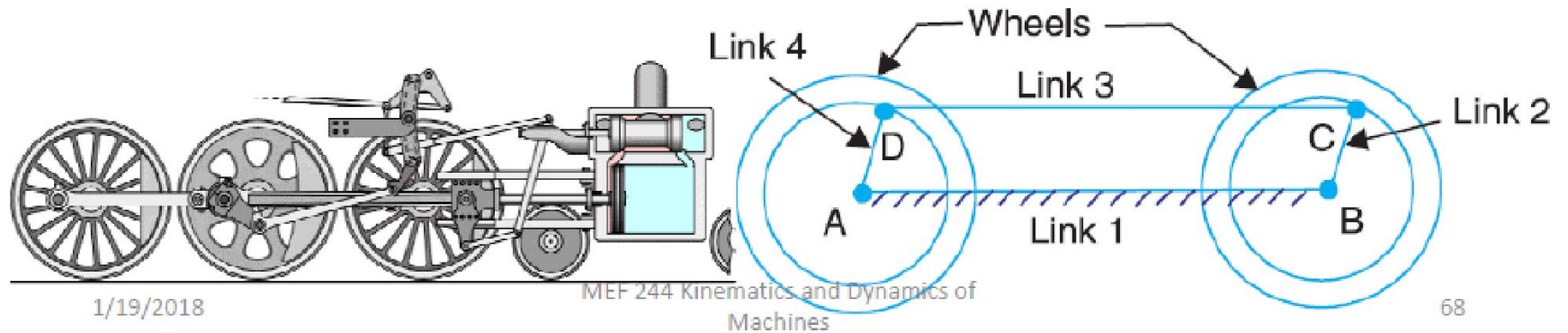
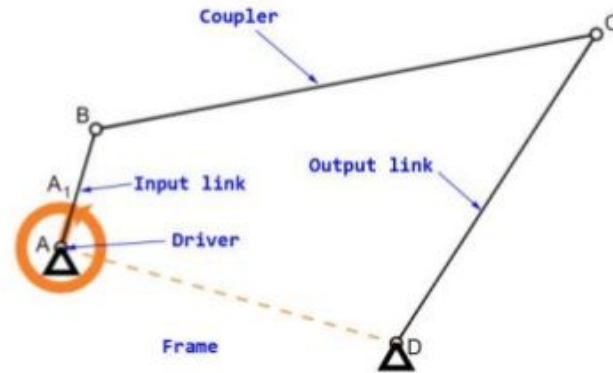


$$L = 4$$

$$J = 4$$

$$H = 0$$

$$\text{DOF} = 1$$



Grashof's Law

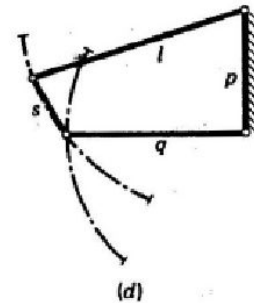
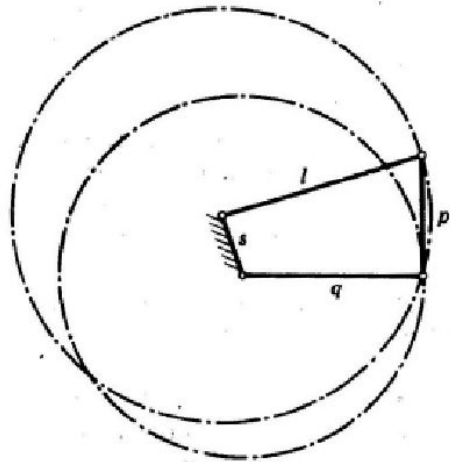
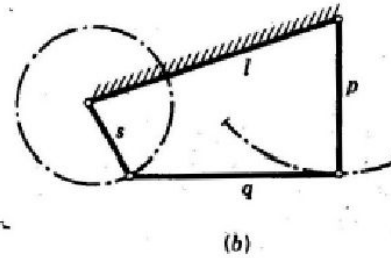
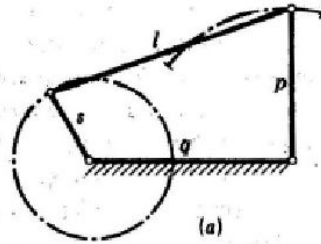
$$S + L \leq P + Q$$

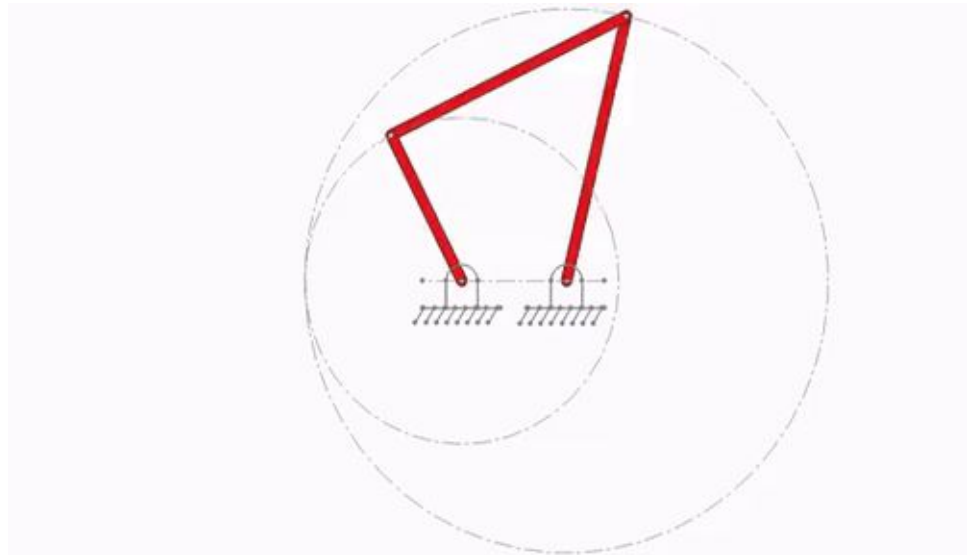
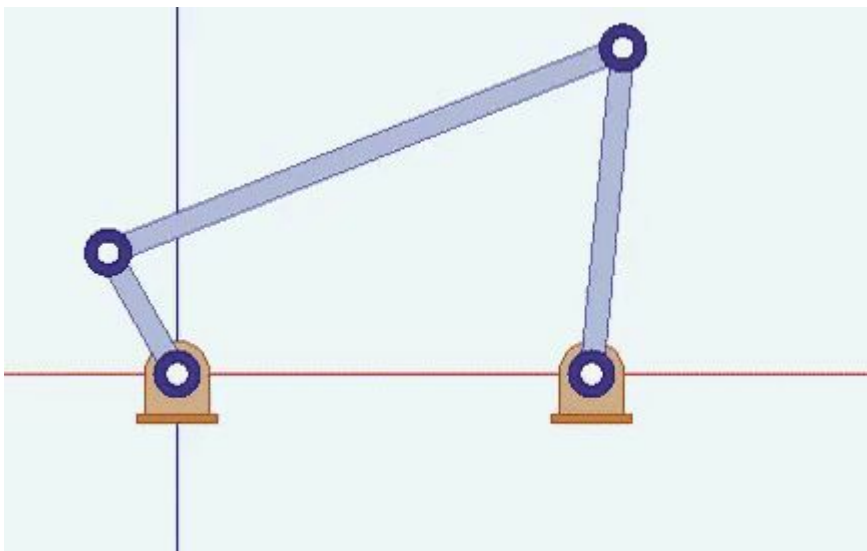
Where s = length of the shortest link

l = length of the longest link

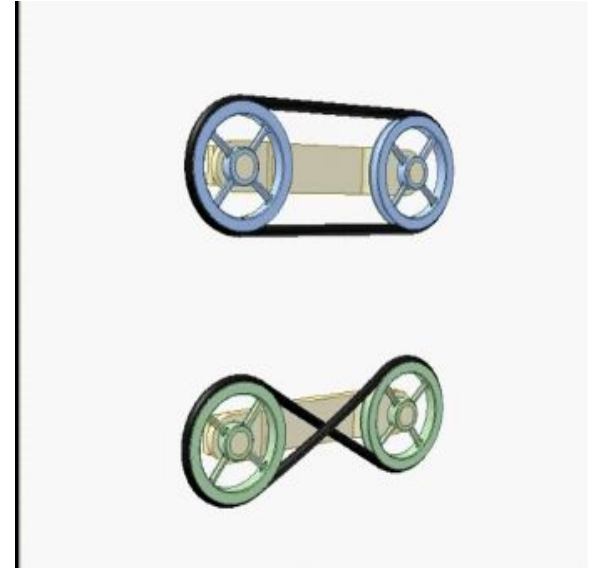
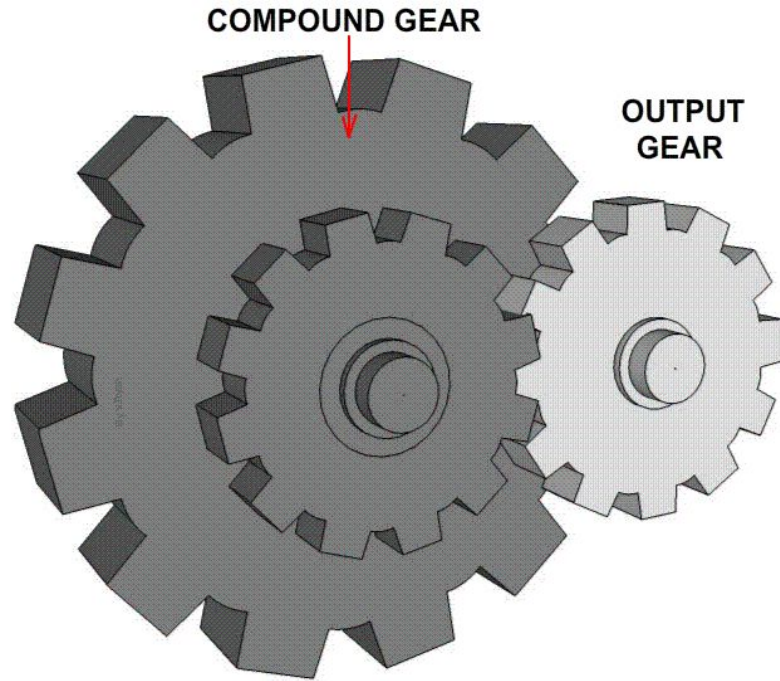
p, q are length of other two links

Inversions of four bar chain:





Some other basic Mechanisms



Steps...

1. Identification of Problem Statement
2. Design and Calculations of the parts to be made
3. Manufacturing of Parts
4. Selection of Mechanical Components
5. Final Assembly
6. Testing
7. Repeat

Manufacturing the First Prototype

Industrial Manufacturing Processes

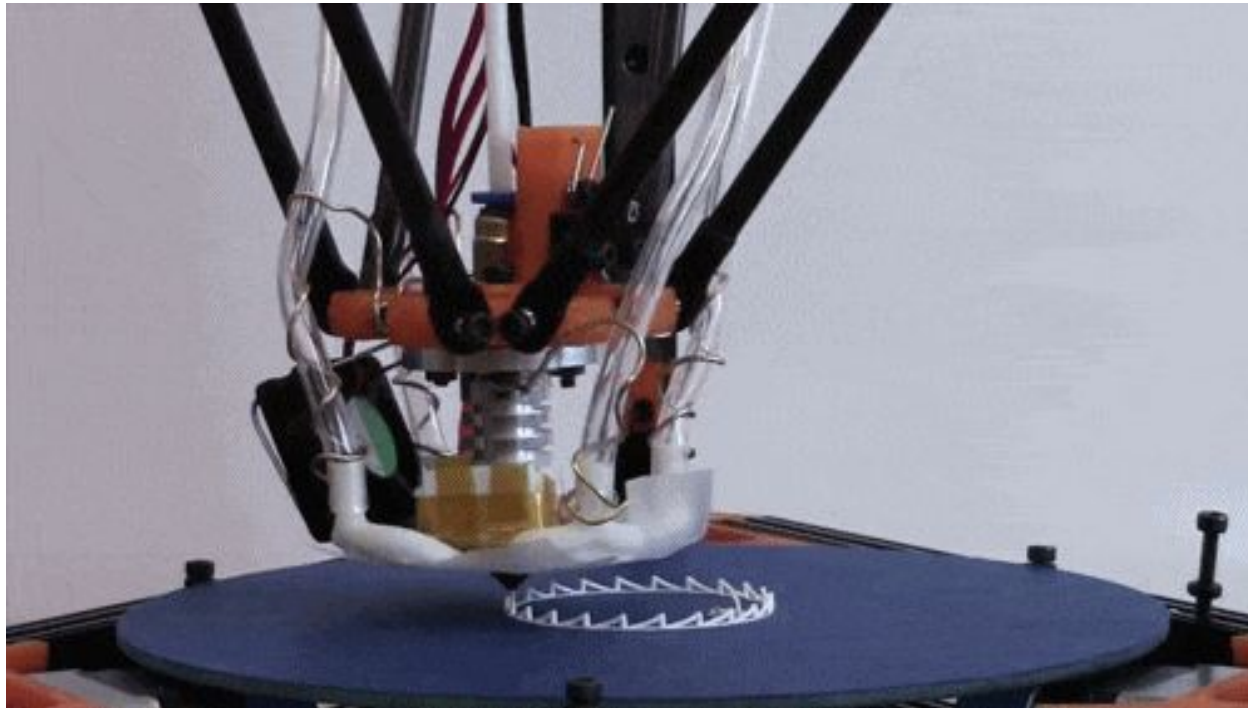
- Forging
- Casting
- Machining

..... So on

Rapid Prototyping Processes

- 3D Printing
- Laser Cutting
- Plasma Cutting

3D Printing



Laser Cutting



Plasma Cutting



Steps...

1. Identification of Problem Statement
2. Design and Calculations of the parts to be made
3. Manufacturing of Parts
4. Selection of Mechanical Components
5. Final Assembly
6. Testing
7. Repeat

Thank You

Tejas Rane
(+91) 99208 90738