

ME220 Theory of Machines and Machine Design

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Textbook: Kinematics & Dynamics of Machinery by R. L. Norton
(for Theory of Machines, TBA for Machine Design)

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What is this course about?

Machines

Any Mechanical/Electrical/XYZ device that transmits or modifies energy to perform any type of work.

- There was a time when a machine required to have moving parts to be classified as a machine.
- Now with many different types of technologies (electronic, optic, etc.) devices without moving parts are also often referred to as machines.

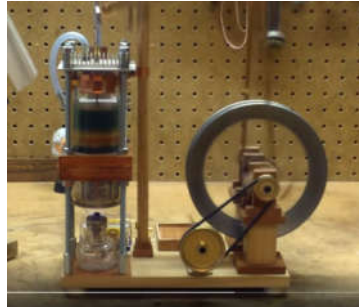
In this course we will be learning about
Machines that are Mechanical in nature.

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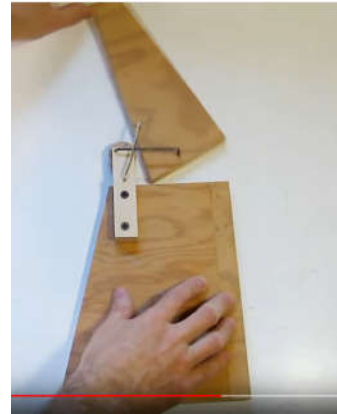
Some Examples



<https://youtu.be/n4ZB8Rg8La0>



<https://youtu.be/CChTFZnNhTE>



<https://youtu.be/agi4FDZY61I>

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Machine Elements

Classification by working principle:

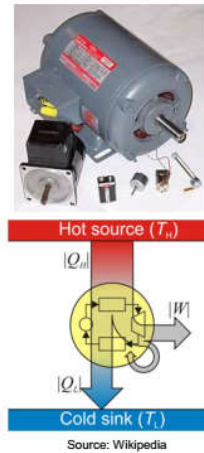
1. Mechanical components (bolts, nuts, shafts, gears, clutches, bearings etc.) ←
2. Non-mechanical components (electrical, optical, electronical etc.)
3. Combined components (sensors, engines, converters etc.)

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Mechanical Components

Engine - converts heat or other forms of energy into mechanical energy

- Electric motor - transforms electrical energy into mechanical energy
- Heat engine - converts heat energy into mechanical energy



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Mechanical Components

Power transmission - provides speed and torque conversions from a rotating power source to another device. Achieved by:

- Belt drives
- Chain drives
- Gear trains



Belt drive
Source: Wikipedia



Gear train
Source: Wikipedia

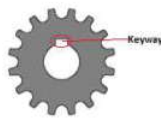
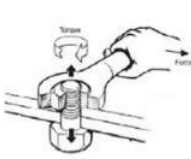
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Mechanical Components

Fasteners and connectors - elements that mechanically join or affix two or more objects together

Classification:

- Permanent fasteners (weldments, rivets)
- Detachable fasteners (bolts, screws, pins, keys etc.)



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Mechanical Components

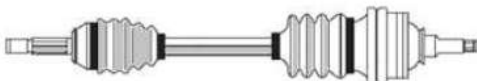
- **Axles and shafts** – to support rotating elements in a machine and fix their rotation axis

- Axle – can be fixed in position or rotate.



Source: Wikipedia

- Drive shaft - mechanical component for transmitting torque and rotation, used to connect other components of a drive train



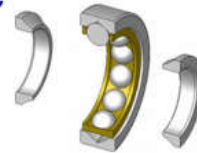
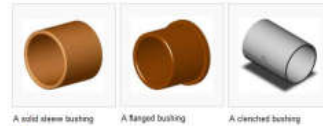
Source: Wikipedia

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Mechanical Components

Bearings - allow constrained relative motion between two or more parts, typically rotation or linear movement

- Plain bearing - comprises just a bearing surface and no rolling elements
- Rolling-element bearing - permits relative motion between two machine members while minimizing frictional resistance



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Mechanical Components

- **Clutches and couplings** – to connect shafts and to transmit movement and torque
 - Clutch - allows connecting and disconnecting the shafts during their operation
 - Coupling – permanent connection between shafts, does not allow disconnection of shafts during their operation

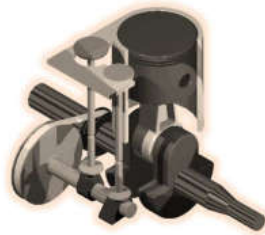


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Mechanical Components

- **Cams and followers**

- Cam – an irregularly shaped element which serves as a driving link and imparts motion to a driven link called the follower.
Enables transformation of rotation to linear motion or vice-versa.



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Mechanical Components

- **Brakes** – a machine element that inhibits motion by absorbing kinetic energy
- **Springs** – a machine element that stores energy or provides a force over a distance by elastic deflection
- **Power screws** – a machine element that translates rotary motion into uniform longitudinal motion



Disc Brake. Source: Wikipedia



Spring. Source: Wikipedia



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