Simple Mechanics

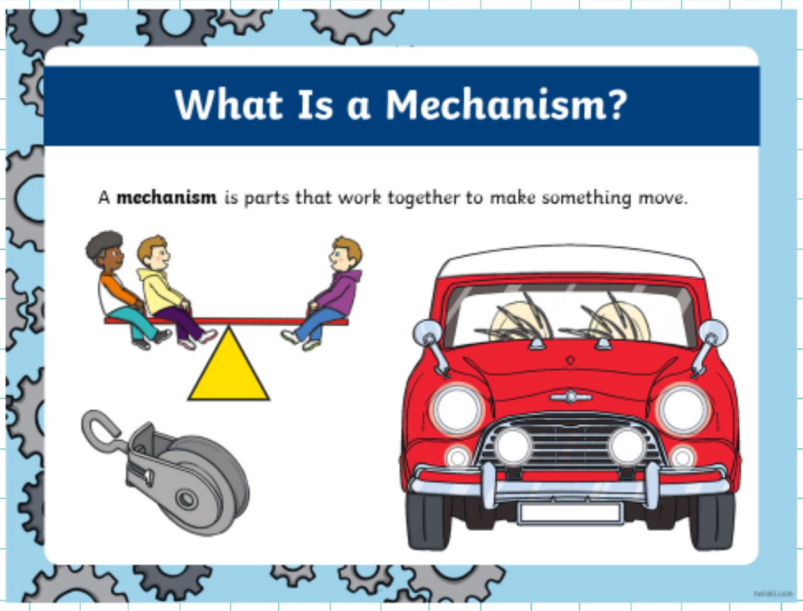
Unit 3
Session 4

Introduction
- Introduction to machines and mechanisms
- Theory of Machines and its basics
- Different types of Mechanisms
- Applications of Mechanisms

1) What are the 4 types of mechanisms?
2) What are mechanisms examples?
3) What is the difference between machine mechanism and structure?

Lesson Aims:
1) Machine and mechanisms working principle
2) Understanding of Gears, belts, chain, pulley drives
3) Application of mechanisms in real world.

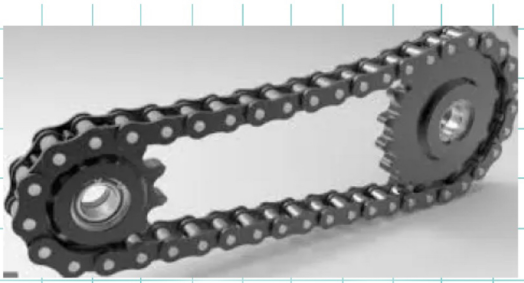
MECHANISM



Gears: Gears are mechanical parts with cut teeth designed to fit with teeth on another part so as to transmit or receive force and motion. Gears are also sometimes called toothed wheels or cogged wheels or cogs. The cut teeth are also sometimes called cogs. Use Reference [2] by scanning the QR Code given in the end.

Belt drive: A belt drive is one of the most popular types of power transmission methods besides gears, chain drives, shaft couplings and lead screws. The use of these highly efficient mechanical drives is increasing with every passing year. Due to the many advances in belt technology, they are now able to meet high-power demands while being extremely safe, efficient and durable. In this article, we shall take a detailed look at the different types of modern belt drives and belt types.

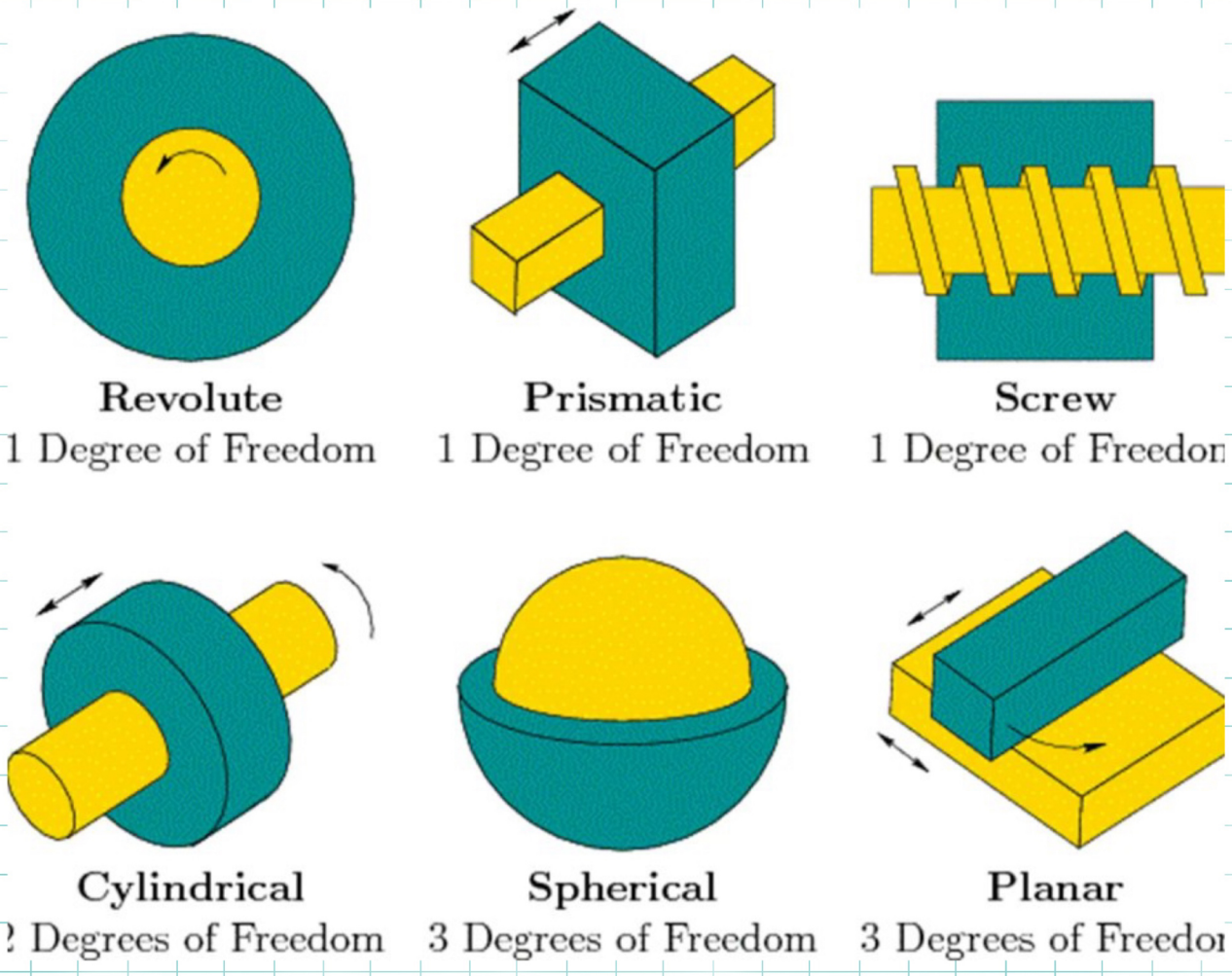
Chain Drive: Chain drive is a way of transmitting mechanical power from one place to another. It is often used to convey power to the wheels of a vehicle, particularly bicycles and motorcycles. It is also used in a wide variety of machines besides vehicles. Apart from these mechanisms there are also various pairs that are associated with mechanisms.



TYPES OF KINEMATIC PAIRS

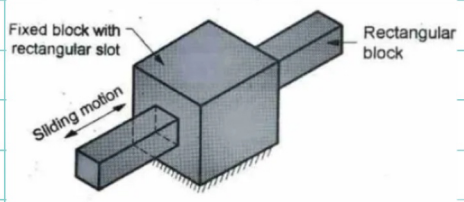
Machines are essential in today's world because they can do things more effectively. Machines can perform our tasks in a faster, quicker, and more effective way. Our phones, laptops, refrigerators, microwaves, etc. are all examples of machines that facilitate us in performing various tasks with ease. A machine is a combination of rigid or resistant bodies, formed and connected in such a manner that they move with definite relative motions.

The two links or parts of a machine when in contact with each other and having relative motion between them are said to form a pair. However, if the relative motion between the corresponding links is completely or successfully constrained in a definite direction, then the pair is termed the Kinematic pair.



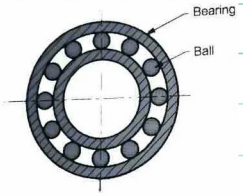
Let's Understand kinematic pairs and their classification systematically.

Sliding Pair: This consists of two components connected in such a way that one is constrained to have a sliding motion relative to another component, Then the pair is known as sliding pair.
Examples: Rectangular bar in a rectangular hole, Square bar in a square hole, Piston and cylinder of an IC engine, Tail- Stock and lathe bed, etc.



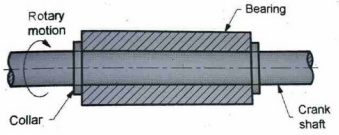
Sliding pair

Rolling Pair: This consists of two elements connected in such a way that one is constrained to roll in another element which is fixed, Then the pair is known as the rolling pair.
Examples: Ball and roller bearings, Wheel rolling on a flat surface and marble rolling on a flat surface, etc.



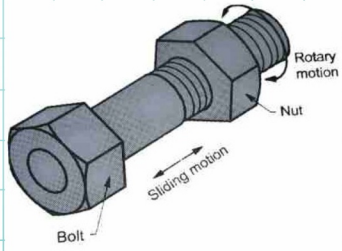
Rolling pair

Turning Pair: This consists of two components connected in such a way that one is constrained to turn or revolve about a fixed axis of another element, Then the pair is known as the turning pair.
Example: Shaft with a collar at both ends revolving in a circular hole, The crankshaft of an IC engine turning in a bearing, Cycle wheels revolving about their axles, etc.



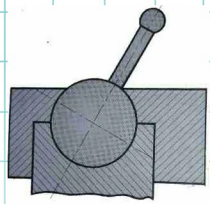
Turning pair

Screw Pair: This consists of two elements connected in such a way that one component turns about the other component through threads. In this scenario, The motion is a combination of turning and sliding.
Example: The lead screw of a lathe and nut, Nut and bolt combination, and Screw with nut of screw jack.



Screw or Helical pair

Spherical Pair: Spherical Pair consists of two elements joined in such a way that one element in the form of a sphere turns about the other fixed element.
Example: Ball and socket joint, Pen stand and Minor attachment of vehicles, etc.


spherical pair

Cylindrical Pair: A pair in which one link has independent revolute and sliding motion relative to the other is themed as a cylindrical pair.
Example: Circular bar in a circular hole and motion of door latch etc.

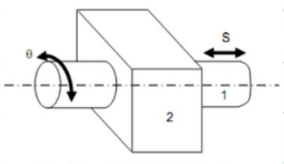


Fig 7: Cylindrical Pair

ACTIVITY

Practical on Gear and Kinematic Pairs:

Watch the animation video to the class.
Each pair gives different kinematic pair for examination.
Rotate each pair for every assignment

1. Lower pair:-revolute pair, prismatic joint, screw pair, cylindrical joint, ball/spherical joint, planner joint
2.Higher pair:-cam gears
3. Wrapping pair:-A wrapping pair is a constraint that comprises belts, chains, and other devices. A belt-driven pulley is an example of this pair. This type of which is very similar to the higher pair(which is having point or line contact), but has multiple-point contact.

Making Gear
1) Cut out a piece of cardboard that is at least 8"x8". This will be your base.
2) On another piece of cardboard, use the compass to trace out at least four circles with 1 inch, 1.5 inch, 2 inch, and 3 inch diameters. Remember that a radius is half the diameter, so if you set the compass radius at 1 inch, you will get a circle with a two inch diameter.
3) Ask your grown-up assistant to help cut out the circles you traced. The rounder your circles are, the better they will work.
Figure out the circumference of each of your circles by multiplying the diameter by π. For example, for the 3 inch circle, the circumference would be about 9.42 inches.
4) Next, you are going to give each of your gears toothed edges. Making sure to cut along the corrugates, cut a long strip of cardboard ¼" wide.
5) Jam your fingernail into the corrugate and carefully remove the brown paper on one side of the corrugated cardboard. You should be left with lots of bumps, without any paper still stuck on. This can be tricky, so be patient!
6) Using the circumferences you calculated, cut out a piece of stripped corrugated cardboard for each of your circles.
7) Cover your work area with newspapers to keep it clean.
Spread glue around the edge of your first circle.
Roll the correctly measured piece of corrugated cardboard around the circle, making sure the bumps are on the outside.
Secure the stripped corrugated cardboard with a push pin or painter's tape until dry.
Repeat for each of your other circles.
8) Let your gears dry overnight.
9) Use a black permanent marker to make a black mark at one tooth of each of your gears. This way you will able to track when each has made a rotation.
10) Attach the 3-inch and 1 ½-inch gears to your board, using pushpins at the center of each and making sure that the gears' teeth interlock.
11) Rotate the 3-inch gear clockwise. Which way does the 1 ½-inch gear turn?
12) Using the black marks to keep track, turn the 2-inch circle once. How many times does the 1 ½-inch gear turn?
13) Now, turn the 1 ½-inch gear once. How many times does the 3-inch gear turn?
14) Arrange the other gears as you wish, and experiment!

REFLECTION

FOR MORE INFORMATION -

1) What mechanisms are typically used in homes?
2) What are the different sources to make these mechanisms?
3) What kinematic pairs are found in your home?