

Kinematic Pair: Definition, Classification with Example

Kinematic Pair:

What is Kinematic Pair?

Kinematic pair is defined as the two links or elements of a machine when in contact with each other are said to form a pair. If the relative motion between them is completely or successfully constrained in a definite direction, the pair is known as Kinematic pair.

According to the following consideration, Kinematic Pair has been classified into three types:

- 1. Types of relative motion**
- 2. Contact and**
- 3. Types of mechanical constraint or Type of closure.**

1. According to types relative motion:

Relative Motion types categorized into 5 parts which are,

- 1. Sliding,**
- 2. Turning,**
- 3. Rolling,**
- 4. Screw and**
- 5. Spherical Pair.**

Sliding Pair:

This consists of two elements connected in such a manner that one is constrained to have a sliding motion relative to another.

Example:

- Rectangular bar in a rectangular hole
- Square bar in the square hole
- Piston and cylinder of an Ic engine.
- Tail-stock and lathe bed, etc.

Turning Pair:

This consists of two elements connected in such a manner that one is constrained to turn or revolve about a fixed axis of another element.

Example:

- Shaft with a collar at both ends revolving in a circular hole.
- The crankshaft of an Ic engine turning in a bearing.
- Cycle wheel revolving about there axles.

Rolling Pair:

This consists of two elements connected in such a manner that one is constrained to roll in another element which is fixed.

Example:

- Ball and roller bearings.

- Wheel rolling on a flat surface.
- Marble rolling on a flat surface.

Screw Pair:

This consists of two elements connected in such a manner that one element turns about the other element by means of threads. The motion, in this case, is a combination of sliding and turning.

Example:

- The lead screw of a lathe and nut.
- Nut and bolt combination
- Screw with nut of screw jack.

Spherical Pair:

This consists of two elements connected in such a manner that one element in the form of a sphere turns about the other fixed element.

Example:

- Ball and socket joint.
- Pen stand
- Minor attachment of vehicles.

2. According to the type of contact:

Types of contact classified as

1. **Lower pair and**
2. **Higher Pair.**

Lower pair:

When the two elements of a pair have surface contact when relative motion takes place and the surface of one element slides over the surface of another element, the pair formed as lower pair.

Example:

- All sliding, Turning and Screw pairs are lower pair.
- Nut turning in a screw.
- shaft rotating in a bearing.
- Universal joint
- All pairs of slider-crank mechanism.

Higher Pair:

When the two elements of a pair have line contact or point contact when relative motion takes place and the motion between the two elements is partly turning, sliding then the pair is known as higher pair.

Example:

- Toothed gearing
- Belt and rope drives
- Ball and roller bearings
- Cam and follower.

3. According to the type of Mechanical constraint / Types of closure:

Types of **Mechanical Constraint** classified into two types,

1. **Self closed pair and**

2. **Force closed pair.**

These are further classified as Self closed pair or closed pair and Force closed pair or Un-closed pair.

Self closed pair or closed pair:

whenever two elements of pair are held together mechanically in such a way that only required the type of relative motion occurs called Self closed pair or closed pair.

Example: All lower pairs.

Force closed pair or Unclosed pair:

whenever two elements of pair are not held together mechanically but are kept in contact by the action of external forces the pair is said to be Force closed pair or Un-closed pair.

Example: Cam and spring-loaded follower pair.