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MADE EASY

MECHANICAL ENGINEERING

Theory Of Machine

By-Amit Kakkar Sir

- Theory
- Explanation
- Derivation
- Example
- Shortcuts
- Previous Years Question With Solution

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Mechanical Engg

↓ Engg of mechanics :- study of system

At Rest :- STATICS

In motion :- DYNAMICS

way-I

- without help of Basic cause of motion i.e. force

⇓

KINEMATICS

$\vec{v} = \frac{d\vec{s}}{dt}$

$\vec{a} = \frac{d\vec{v}}{dt}$

→ mass (X)

way-II

- with the help of force

⇓ (or)

KINETICS | Dynami of m/

N.S.L of motion

$\Sigma F_{ext} = \frac{d}{dt}(mv)$

↓

(ma)

Theory of machine = Kinematics + Dynamic m/c + Vibration

Syllabus :-

1. Simple mechanism
2. Instantanous Centre method APP
3. Relative velocity APP
4. Acc^n Analysis
5. Gears.
6. Gears Trains
7. Governors
8. Dynamic Analysis
9. Flywheel
10. Balancing.
12. Gyroscope
13. Cam and follower
14. Mechanical Vibration

Weighlage :-

- Gate :- min 8 marks
- ESE :- . Prelims :- min [22-30] Q of Tom out of 150 Q
  . mains :- more than 100 marks of Tom.

Paper-II = 300 marks

After completing Topic; from where should we attamp Question ??

1. Workbook [madeeasy] *
2. GATE [PYQ]] Revision
3. E.S.E - [PYQ] objective]
4. Test Series

Simple Mechanism

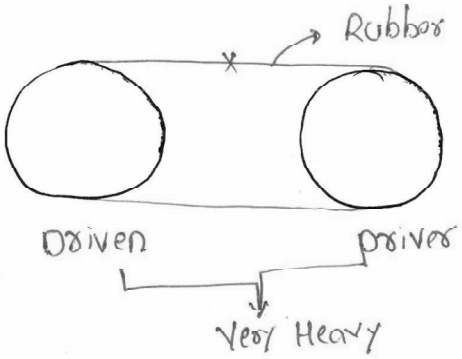
Kinematics link / element / member / Link

- " Every part of the m/c which is having some relative motion with respect to other part will be known as kinematic Link (or) element (or) member (or) Link"

for Link :— It must be a resistant body
- Capable for transmitting force (or) torque (or) power (or) motion from one element to other element

when ever body behaves as resistant body (or) not, it depends upon:-
1. Body itself
2. its surrounding

for Ex :-



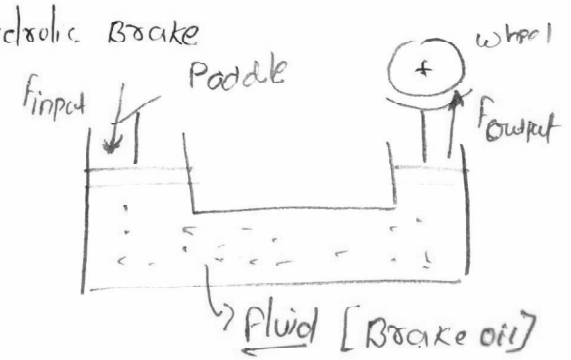
Different type of Link's

1. Rigid link :- Deformation are negligible w.r.t dimension of the link
   Ex :- Crank, GR, Piston, Cylinder.

2. Flexible link :- Deformation are not negligible w.r.t dimension of link
   Ex :- Spring, Belt / Ropes.

3. Fluid Link :- When power is transmitted ~~between~~ because of fluid pressure
   Either - Liquid (or) gas

   Ex :- Hydraulic Brake



More Ex :- Hy. Jack
Hy - Ram
Hy - Lift
Hy. Crane.

Different types of relative motion

→ For a relative motion :- System will be having two link.

→ Only those two link will be the part of system, in between Relative motion is being observed

Ex :- motion of Crank w.r.t C.R
↳ System

① Completely Constrained motion
② Successfuly Constrained motion
③ In Completely Constrained motion

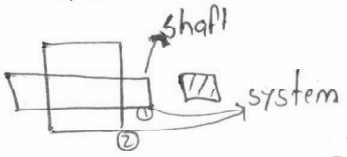
→ Constrained motion :- Desired motion obtained [unique output]

→ unconstrained motion

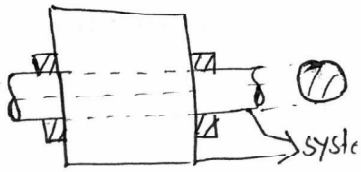
) Completely Constrained motion

→ Hear motion is Constrained by system itself

Ex :- (i) Square shaft in square hole.



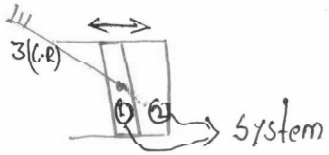
(ii) Circular shaft in Circular hole with collar.



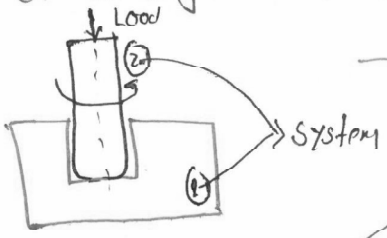
) Successfuly Constrained motion

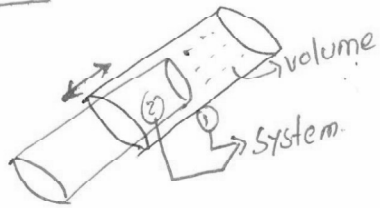
→ Hear motion is Constrained by surrounding link.

Ex :- (i) motion of piston inside the cylinder of IC engine -



(ii) Shaft in foot step Bearing





) In-Completely Constrained motion

→ Hear motion is not Constrained

Ex :- Door Bolt

NOTE:- . Constrained motions are highly practically used.

. Un Constrained motions are very rarely used.

Kinematic pair / Pair / Joint

" Any Connection between two Link is known as pair or ~~tin~~ Joint"

this pair (or) Joint may or may not be Constrained pair depending upon relative motion at the Connection be Constrained (or) un Constrai

Classification of Pair (or) Joint

(A) According to the type of Relative motion

(1) Turning pair (Revolute Pair) (or) Pin Joint

→ Relative motion ⇒ Pure Turning.

Ex:- Crank pin, Gydgeon pin, Shaft-Bearing

Constrained pair

(2) Sliding pair (or) Prizmatic pair

→ Relative motion ⇒ Pure sliding.

Ex:- Pyston-Cylinder, key-key-bulky

Constrained pair

(3) Screw pair

→ Relative motion ⇒ over the threads

Ex:- Nut-bolt, Bottl-bottle cap.

Constrained pair

!→ independent motion is only Rotation

(4) Spherical pair (or) Ball in Socket Joint



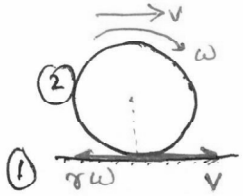
→ Relative motion ⇒ 3-D Rotation → Spherical motion

Ex:- Pen stand, Joy stick, mirror of Scooty

Constrained pair

⑤ Rolling pair

→ Relative motion ⇒ Rolling

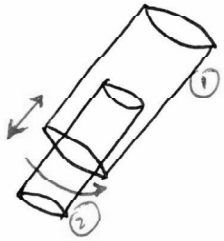


If $v = r\omega$ ⇒ Pure Rolling [No slipping]] Independent motion → 01 (Rotation)
⇒ Constrained pair

If $v \neq r\omega$ ⇒ Rolling [Slipping]] Independent motion → 02 (Rotation + Trans)
⇒ Unconstrained pair.

⑥ Cylindric pair

→ Relative motion ⇒ Between two co-axial cylinder in contact.



Ex:- Door Bolt

→ Independent motion = 02 [Rotation, Reciprocating)

Unconstrained pair.

Flat Pair

→ Relative motion ⇒ between two flat surface in contact

Unconstrained pair

Ex:- Table - mouse

→ No of independent motion = 03 [Two translation + One Rotation

(B) According to the type of Contact

(i) Lower pair [L.P]

→ Surface contact (or) Area contact

Exe — • Turning pair [T.P]
• Sliding pair [SP]
• Screw pair
• Spherical pair
• Cylindrical pair
• Flat pair

1 Higher pair = 2 Lower pair

(ii) Higher pair [H.P]

→ Point (or) Line contact (or) zero Area contact

Exe — Rolling pair
Pair b/w Cam and follower

(iii) Wraping pair :- Involved when one of the link is flexible.

→ When one Link is wrapped over other Link → Here multible point contact existe.
⇓
→ Therefore this pair is close to Higher pair

Exe — Chain - Sproket
Belt pully

) # According to the type of Closure

① Self closed pair [closed pair]

→ Permanant Connection :- No Continous force is required to maintain the Connection

Ex :- T.P, S.P

② Forced closed Pair [Open pair]

→ Continous force is required to maintain Connections

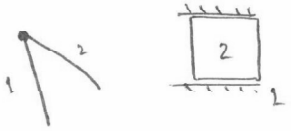
Ex :- . Pair b/w Cam and follower
. Door closers
. Automatic Clutch operating system

Different type of pair (or) Joint

→ [Only for Lowers pair]

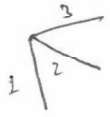
) Binary Joint

→ where two link are connected



② Ternary Joint

→ where three link are attached

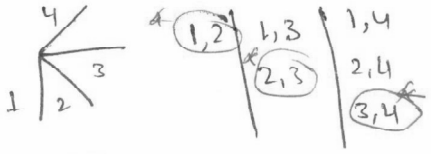


* 1,2 → B] Independent
* 2,3 → B
1,3 → B

1 Ternary Joint ≡ 2 Binary Joint

③ Quadernary Joint

→ where four link are connected



1 Quadernary ≡ 3 Binary Joint

NOTE :- In furthure more study All the L.P are being counted as effective no of Binary Joint. Represented by 'j'

→ where as no of Higher pairs counded as saprately as H.P represented by 'h'

Kinamatic chain

" If All the links are connected in such a way such that first link is connected to the last link in order to have closed chain and If all the relative motions in this closed chain are constrained than this chain is known as kinamatic chain. therefore kinamatic chain is also known as constrained chain

Kinamatic chain [constrained chain] → (To used this chain one link must be fixed (ground)) → MECHANISM → (use) → MACHINE

MECHANISM:
- ⇒ which can be give desired output w.r.t given input
- * Share, concept
- * what to do

MACHINE:
- Desired output is obtained
- * Engg^n
- * How todo