WEEK1

Common terms used in Measuring Instruments

1. Least Count The smallest value that a measuring instrument can read. Example: A vernier caliper has a least count of 0.02 mm.

2. Accuracy The closeness of a measured value to the true value. High accuracy means the measurement is very close to the correct value.

3. Precision. The ability of an instrument to give the same reading repeatedly. An instrument can be precise but not accurate if it gives consistent but wrong readings.

4. Calibration The process of setting and checking a measuring instrument against a standard to ensure accuracy.

5. Range The maximum and minimum values an instrument can measure. Example: A micrometer may have a range of 0-25 mm.

6. Zero Error An error that occurs when the instrument does not read zero even when the measurement is zero. This error must be corrected for accurate results.

7. Parallax Error An error that occurs when the observer's eye is not in line with the scale reading: These errors are common in analog instruments

WEEK2

Activity - Identification of Ferrous materials

The students shall prepare the chart showing the Mechanical, Thermal, Electrical, Chemical and Magnetic properties Engineering Materials

Objectives

1. To help students understand the importance of material selection.

2. To promote observation and practical application of engineering materiais knowledge.

3. To connect theoretical learning with real-world components.

Instructions:

1. The total number of students will be divided equally into i batches. (Batches may vary).

2. Each batch will be assigned a unique set of 5 to 10 engineering components made fimm Cast Iron, Steri, or Alloy Steel.

3. Every student in the batch should actively contribute to researching, identifying, and completeing the chart/worksheet for all components.

Task Questions:

1. Identify the Material Used for each Applications.

2. Last Key Properties.

3. Explain the Application

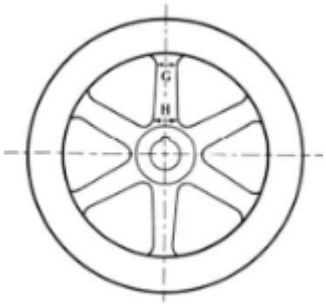
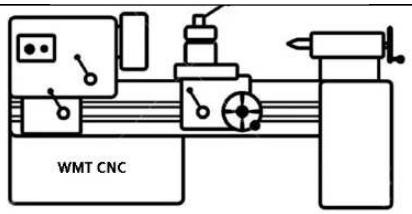
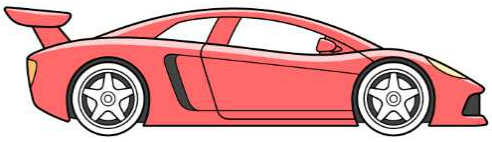
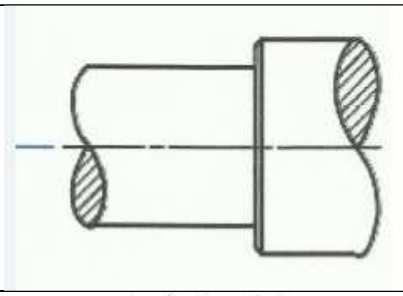
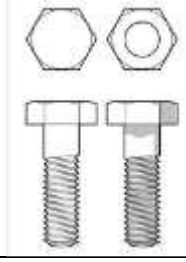
4. Provide Visual Representation.

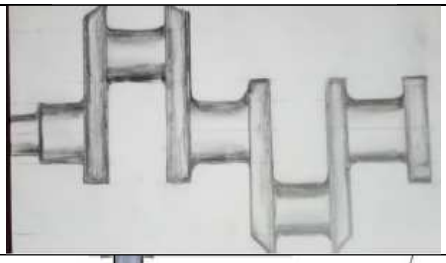
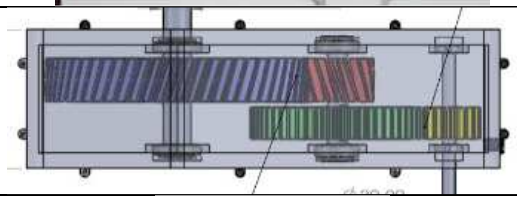
Activity - Identification of Engineering materials

Activity Allotment - Material Identification Task:

Batch - 1	Batch - 2	Batch - 3
Cast Iron Components (Civil & Utility Focus)	**Automotive Components (Mild & Alloy Steel)**	**Machine & Structural Steel Parts**
• Sewage Pipe • Manhole Cover • Machine Tool Bed • Flywheel • Pump Casing • Gear Housing • Wear Plate • Lathe Base • Bench Vise Body • Cylinder Block (older)	• Car Chassis • Car Body • Axles • Laminated Leaf Spring • Exhaust Pipe • Shafts • Fasteners • Bumper reinforcement • Steering arm • Brake Disc	• Clamps and Fixtures • Tool holder • Bolts and Nuts • Supporting frame • Connecting Rod • Gears • Hydraulic piston Rod • Machine shaft • Column Bracket • Jig Plate

Batch - 4	Batch - 5	Batch - 6
Railway & Heavy Industry Components	**Marine and Fluid Machinery Components**	**Tools, Sheet Metal & Cutting Devices**
• Railway Rails • Axles (Train) • Wheels (Train) • Brake Block • Coupler • Ball Mill Shell • Shaft (Industrial) • Crank • Drive Gear • Gearbox Casing	• Marine Pump Impeller • Pump Casing • Valve Body • Propeller Shaft • Coupling Hub • Oil Seal Housing • Water Jet Nozzle • Hydraulic Cylinder • Pipe Flange • Pipe Support Bracket	• Wrench / Spanner • Pliers • Welding Electrodes • Sheet Metal Panel • Screwdriver Blade • Drill Bit • Saw Blade • Hacksaw Frame • Punch Tool • Tap and Die

S.NO	Component name	Materials used	Properties	Application	Sketch
1	Flywheel	cast Iron	High tensile strength, high fatique resistance	Traditional engines, automobile	
2	Lathe base	Cast iron	High vibration damping, high compressive strength	High precision CNC lathes	
3	Car body	alloy Steel	Corrosion resistance, durability	Car body panels	
4	Shafts	alloy steel	High tensile strength, toughness	turbines	
5	Bolts and nuts	Carbon steel	Tensile strength, corrosion resistance	Automotive & construction	

6	Gears	Steel	High wear resistance, high strength & toughness	Automotive transmissions	
7	Crank	Carbon steel	Toughness, tensile strength	Cranks in general machines	
8	Gear box casing	Cast iron	High strength & rigidity	Industrial gearboxes	
9	Drill bit	High speed steel	Hardness, wear resistance	General purpose drilling in wood, plastic , mild steel	
10	Saw blade	High carbon steel	Hardness and toughness	Wood working	

WEEK3

Activity - Identification of Nonferrous materials

Objectives:

To understand the composition, properties, and applications of non-ferrous materials through (real-world components) and (hands-on investigation

Instructions:

1. The total number of students will be divided equally into 6 batches. (Batches may vary)

2. Each batch will be assigned a unique set of 5 to 10 Non-ferrous components made from Aluminum, Copper, Nickel, Zinc and its alloys.

3. Every student in the batch should actively contribute to researching, identifying, and completing the Chart/worksheet for all components.

Task Questions:

1. Identify the Material Used for each Applications.

2. Last Key Properties.

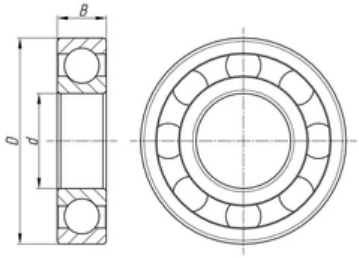
3. Explain the Application

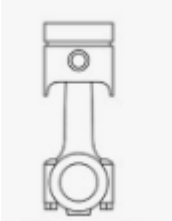
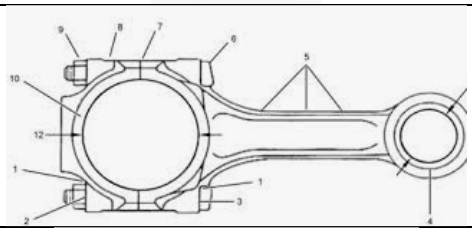
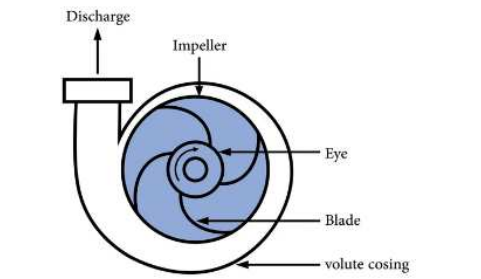
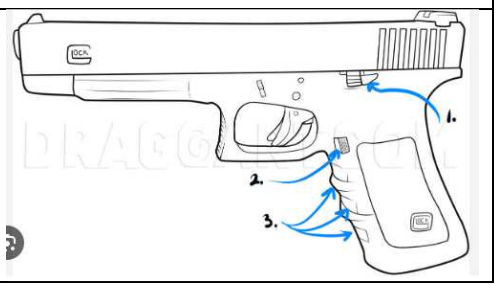
4. Provide Visual Representation.

Activity - Identification of Engineering materials

Activity Allotment - Material Identification Task:

Batch - 1	Batch - 2	Batch - 3	Batch - 4	Batch - 5	Batch - 6
• Rivet • Wire • Solder • Turbine blade • Ornaments • Fan bearings	• Food foil • Bell • Door handle • Heat exchanger • Badges • Washing machine bearings	• Piston • Bush • Name plate • Propeller • Batteries • Medals	• Bike frame • Decorative parts • Lock • Musical instruments • Connecting rods • Trophies	• Cooking vessel • Water Pump parts • Exhaust manifold of aircraft engines • Cutting tool inserts • Utensils • Chemical industry equipments.	• Bike frame • Decorative part • Gun parts • Refrigerators tubes • Plumbing fittings • Electrical wires

S.No	Component name	Materials used	properties	application	Sketch
1	Fan bearing	Chrome steel	High hardness, corrosion resistance	Industrial fans	
2	Bell	bronze	Hardness and corrosion resistance	Church bells	

3	Piston	Steel alloys	High strength to weight ratio, thermal conductivity	Heavy duty diesel engines	
4	Connecting rod	Carbon steel	High tensile and compressive strength	motorcycles	
5	Water pump parts	Cast iron	Corrosion resistance and wear resistance	General purpose water pumps	
6	Gun parts	Steel	High strength, hardness	Barrels, bolts, firing pin	

WEEK4

Objectives: To help students understand and compare different engineering material properties by creating a visual chart highlighting their mechanical, thermal, electrical, chemical, and magnetic behaviors.

Instructions:

1. The total number of students will be divided equally into 6 batches. (Batches may vary).
2. Each batch will be assigned a unique set of 5 to 10 Engineering materials
3. Identify the material used and list out its mechanical, thermal, electrical, chemical, and magnetic properties

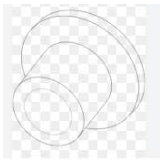
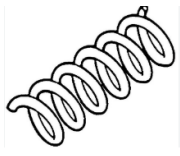
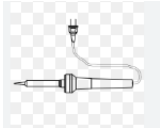
Task Questions:

1. Identify the Material Used for each Applications.
2. Last Key Properties.
3. Explain the Application
4. Provide Visual Representation.

Activity - Identification of Engineering materials

Example: like this

Batch - 1	Batch - 2	Batch - 3	Batch - 4	Batch - 5	Batch - 6
• Rivet • Gears, • Brake pads • Cutting tools • Glass • Axles • Laminated Springs	• Bearings • Machine frames • Propellers • Propellers • Rivets • Connecting rods	• Shafts • Pipes • Manhole covers • Bushes • Gun Parts • Bells	• Springs • Valves • Car Body Panels • Car Body Panels • Exhaust Systems • Sheet Metals	• Fasteners (Nut, Bolt, Screw) • Utensils • Food wrapping foils • Electrical Connectors • Water pump parts • Solders	• Electrical wire • Flywheels • Refrigerator Tubes • Heat exchangers • Railway tracks • Ball Mills

S.No	Component name	Materials used	Mechanical Properties	Thermal Properties	Electrical Properties	Chemical Properties	magnetic Properties	sketch
1	Glass	Silica (SiO_2)	brittle	Low thermal conductivity	High resistivity	solvents	diamagnetic	
2	Propellers	Bronze alloy	High tensile strength	Moderate thermal conductivity	Generally poor conductors	Excellent corrosion	Non-magnetic	
3	Bushes	Brass	Good wear resistance	Operating temperature range varies	conductive	Good corrosion resistance	ferromagnetic	
4	Springs	Carbon steel	High tensile strength	Up to 200°C	Metals conduct electricity	Susceptible to rust without coating	ferromagnetic	
5	Solders	Tin - lead	Relatively low tensile strength	183-190°C	Good electrical conductivity	Corrosion resistant when properly alloyed and flux used	Generally non-magnetic	

6	Electric wire	copper	High ductility and tensile strength	Copper and aluminium conduct heat well	Excellent electrical conductivity (~5.8×10^7 S/m)	Corrosion resistant but can oxidize (forms green patina)	Non-magnetic	

WEEK5

Objectives: help students identify and understand different Non-Metals by creating a visual chart highlighting their properties and applications.

Instructions:

1. The total number of students will be divided equally into 6 batches. (Batches may vary).
2. Each batch will be assigned a unique set of 5 to 10 Non-metals.
3. Identify the material used and list out its properties and applications.

Task Questions:

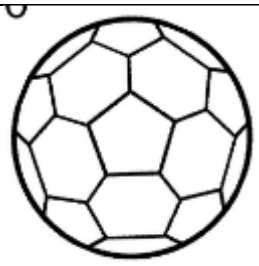
1. Identify the Material Used for each Applications.
2. Last Key Properties.
3. Explain the Application
4. Provide Visual Representation.

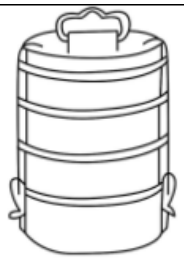
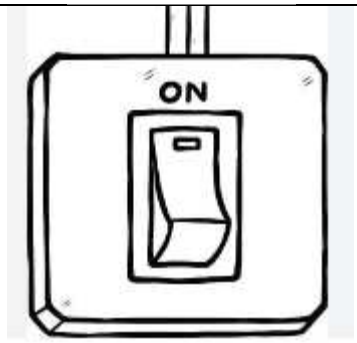
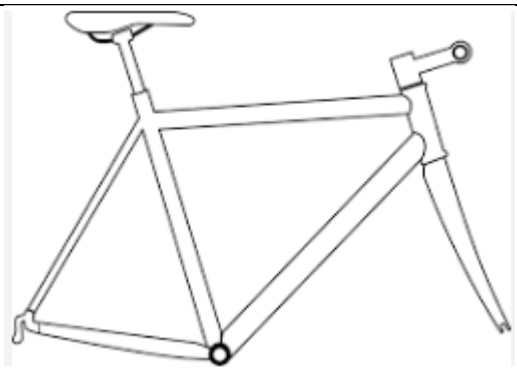
Activity - Identification of Engineering materials

Example: like this

Activity Allotment - Material Identification Task on mechanical properties task

Batch - 1	Batch - 2	Batch - 3	Batch - 4	Batch - 5	Batch - 6
• Sporting goods • Bumpers • Electrical insulators • Capacitors • Buckets • Disposable cups	• Packaging • Aircraft wings • Cutting tools • Bone replacements (Zirconia). • Plumbing Pipes • Dashboard panels	• Rocket nozzles • Roofing panels • Biomedical implants (hip joints) • Thermal shields • Cable insulation • Food container	• Gas turbines • Tennis rackets • Refractories (furnace linings) • High-temperature components in engines and reactors • Plastic Gears • Electrical switches	• Bicycle frames • Boat hulls • Fuse Holder • Armor plates • Helmets • Handles of utensils	• Car body panels • Space shuttle parts • Abrasives (grinding wheels, sandpapers) • Cutting and drilling tools • 3D printing • PCB laminates

S.NO	Component name	Material used	properties	Application	Sketch
1	Sporting goods	Natural and synthetic	Lightweight	balls, grips, shoe soles	

2	Cutting tools	High-Speed Steel (HSS)	Hardness	drill bits, taps, reamers, lathe tools	 HAND REAMER
3	Food container	Aluminium	Food Safety	Tiffin box	
4	Electric switches	Thermoplastics (e.g., Polycarbonate)	High strength and durability to withstand repeated switching	Electrical plugs	
5	Bicycle frames	Steel	High-tensile steel, (Chromium-Molybdenum alloy)	Cycle	
6	3D printing	Thermoplastics	strength, flexibility	Prototype making	

WEEK8,9

Students shall prepare and demonstrate the simple mechanisms using models

1.Write the any one working principle and its mechanism of slider crank mechanism with sketch

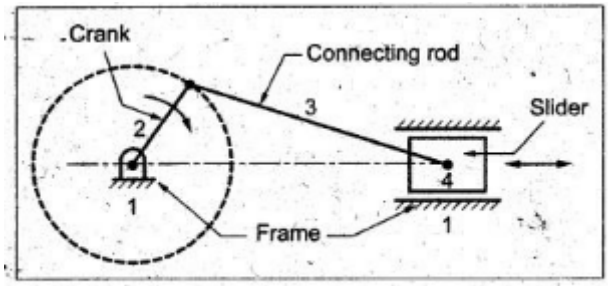


Fig. 1.33. Single slider-crank chain

□ Definition:

The **Slider Crank Mechanism** is a mechanical system that **converts rotary motion into reciprocating motion**, or **reciprocating motion into rotary motion.**

It is the **basic working mechanism** of many machines, such as internal combustion engines and reciprocating pumps.

□ Working Principle

- The **crank** is rotated (by a motor or manually).
- This rotation is transferred to a **connecting rod**, which links the crank to a **slider** (also called a piston).
- The crank's rotary motion causes the slider to move in a straight line back and forth.
- Conversely, if the slider is pushed (like in an engine), it causes the crank to rotate.

□ Types of Motion Conversion:

Input Motion	Output Motion	Example
Rotary (crank)	Reciprocating (slider)	Internal combustion engine
Reciprocating (slider)	Rotary (crank)	Reciprocating pump

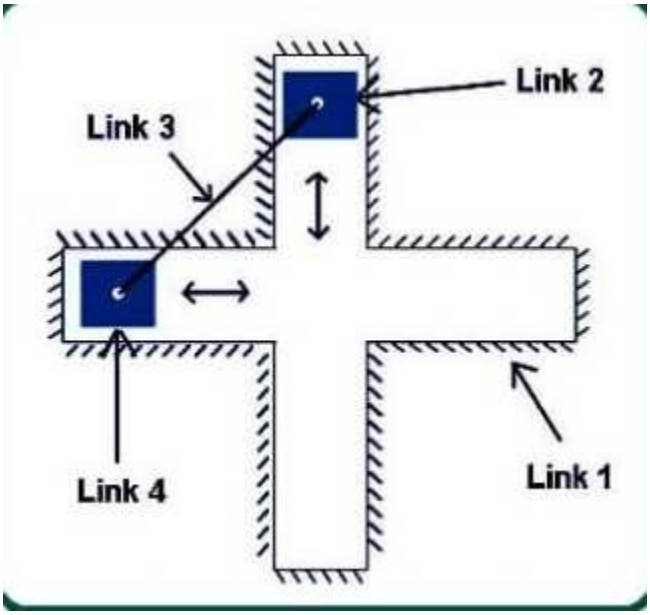
□ Main Components of Slider Crank Mechanism

Component	Function
Crank	Rotates and provides motion
Connecting Rod	Connects the crank to the slider
Slider (Piston)	Moves in a straight (reciprocating) line
Frame	Fixed structure holding the mechanism

□ Mechanism Types Based on Application

1. Engine (e.g. petrol engine):
   - **Input:** Piston moves (due to combustion)
   - **Output:** Crankshaft rotates
   - **Use:** Car engines, motorcycles
2. Pump or Compressor:
   - **Input:** Motor rotates crank
   - **Output:** Piston moves (draws or compresses fluid)
   - **Use:** Water pumps, air compressors

2.Write the any one working principle and its mechanism of double slider crank mechanism with sketch



 **Definition:

A Double Slider Crank Mechanism** is a type of **inversion of a single slider crank** where **two sliding pairs** are present. It converts **rotary motion into another rotary motion** or **oscillatory motion into linear motion**, depending on the configuration.

Main Components

Part	Function
Fixed Link (Frame)	Supports and holds the mechanism in place
Sliders (2)	Move in linear directions (at right angles)
Connecting Link (Crank/Coupler)	Connects the sliders and allows motion transfer

□ Working Principle

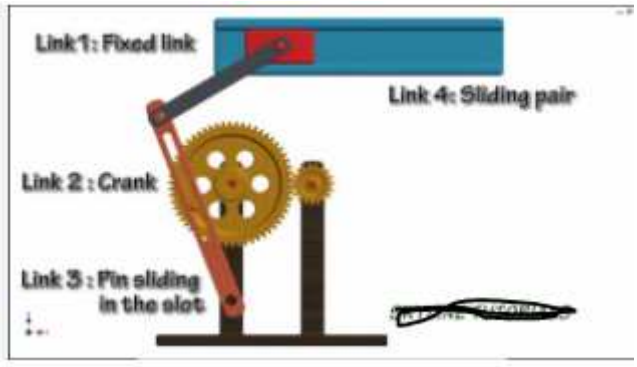
- The mechanism consists of **two sliders** connected by a **link (coupler)**.
- When **one slider moves** in a straight line, the **coupler rotates**.
- This causes the **second slider** to move **perpendicular** to the first slider's direction.
- The result is a motion conversion between **two linear sliders at 90° angles**, with a **rotating link in between**.

□ Mechanism Example: Elliptical Trammel

The most common example of a double slider crank mechanism is the **Elliptical Trammel** (also called "Trammel of Archimedes").

- **Two sliders** move in perpendicular slots.
- The **connecting link (crank)** rotates and traces an **elliptical path**.
- Used for drawing ellipses and in some **machine tools**.

3.Write the any one working principle and its mechanism of quick return mechanism with sketch



□ Definition:

A **Quick Return Mechanism** is a mechanical system used in machine tools (like **shapers**, **slotters**, and **slotting machines**) to **convert rotary motion into reciprocating motion**, where the **return stroke is faster than the forward stroke**.

□ Working Principle

- The mechanism is designed so that the **tool (or slider)** moves **slowly during the cutting (forward) stroke** and **quickly during the return stroke**, increasing efficiency.
- This is achieved by using a crank and slotted lever or Whitworth link to create **non-uniform reciprocating motion** from a rotary input.

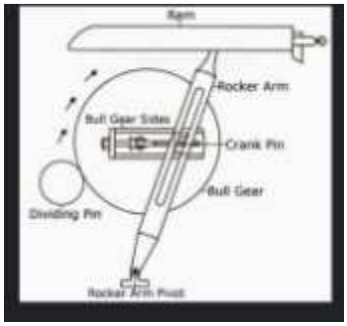
□ Main Components (General)

Component	Function
Crank (Rotary input)	Rotates continuously to drive the mechanism
Slotted Lever or Ram	Connects crank to the slider
Ram/Slider	Holds the cutting tool and performs linear motion
Ram Guide/Frame	Provides support and guides motion

□ Mechanism Overview (Crank and Slotted Link Type)

1. **Crank** rotates, connected to a **slotted lever**.
2. The **slotted lever** connects to a **ram** or **slider**.
3. As the crank rotates, it moves the ram forward slowly (cutting stroke).
4. As rotation continues, the return stroke happens faster due to geometry of the linkage.

4.Write the any one working principle and its mechanism of crank and slotted mechanism with sketch



□ Definition:

The **Crank and Slotted Lever Mechanism** is a type of quick return mechanism used mainly in **shaper machines** to convert **rotary motion into reciprocating motion** with a **quick return stroke**.

It consists of a crank, a slotted lever, a ram (slider), and a ram holder (or tool holder).

□ Main Components

Component	Function
Crank	Rotates continuously, driven by a motor or handwheel
Slotted Lever	Connects the crank and ram, contains a slot for the crank pin to slide
Ram (Slider)	Moves back and forth (reciprocates) and holds the tool
Ram Holder	Supports the ram and guides its linear motion
Fixed Frame	Holds the mechanism together and provides support

□ Working Principle

- The **crank** rotates continuously.
- The crank pin moves inside the **slot of the slotted lever**, causing the slotted lever to oscillate about its fixed pivot.
- The slotted lever is connected to the **ram (slider)**, which moves in a reciprocating straight line.
- Due to the geometry of the crank and the slotted lever, the forward stroke of the ram is **slower**, and the return stroke is **faster** — this is the **quick return motion**.
- The tool attached to the ram cuts the material during the slower forward stroke.
- The faster return stroke saves time by quickly moving the tool back to the start position without cutting.

5.Write the any one working principle and its mechanism of four bar chain mechanism with sketch

□ Definition:

The **Four Bar Chain Mechanism** is one of the simplest and most common mechanisms in mechanical engineering, consisting of **four rigid links connected by four revolute (rotary) pairs** forming a closed loop or chain.

It is mainly used to convert rotary motion into a different type of motion (rotary or oscillatory), and to transmit motion and force.

□ Components (Links)

Link Name	Description
Frame (Fixed Link)	Fixed and does not move; supports mechanism
Input Link (Crank)	Connected to input motion source; rotates continuously or oscillates
Coupler Link	Connects input and output links; transmits motion
Output Link (Rocker/Lever)	Produces output motion; rotates or oscillates

□ Working Principle

- The mechanism forms a **closed four-bar loop** with four links connected by four revolute joints.
- The **input link (crank)** rotates (either fully or partially).
- The **coupler link** transfers motion between the input and output links.
- The **output link** (rocker or follower) moves depending on the geometry:
  - It may rotate fully (if long enough).
  - Or oscillate (rock back and forth) if shorter.
- The motion relationship depends on the **lengths** ↓ **the four links**.