

## 1. ADC and DAC

\* ADC (Analog to Digital Converter):

An ADC converts an analog signals (Such as voltage, temperature, or pressure) into a digital signal that a microcontroller or PLC can understand.

(ADC एक ऐसा device है जो analog signal (जैसे voltage, temperature, pressure etc) को digital signal में convert करता है।)

Why it's important :-

Most real-world signals from sensors are analog, but digital system (like PLC or microcontrollers) only process digital data.

Hence, ADC are essential.

(Microcontroller या PLC digital values ही स. पाते हैं, लेकिन sensors mostly analog data देते हैं, इसलिए उन्हें digital में convert करना पड़ता है।)

How it works :-

- It takes a continuous analog voltage input (Sensor से analog voltage आता है, 0-5V या 0-10V)
- Converts it into a discrete digital value.

eg. A 10-bit ADC converts 0-5V into digital values ranging from 0 to 1023

## Diploma Dalkahin



( ADC ले voltage को discrete digital value में convert करता है जैसे 10-bit ADC 0-1023 तक values देता है। )

Real life example:-

Temperature sensor  $0V = 0^{\circ}C$ ,  $5V = 100^{\circ}C$  देता है।  
ADC लेते 0-1023 digital number बताता है  
जिसे controller समझ सकता है।

\* DAC ( Digital to Analog converter):

A DAC converts digital values (from controller or analog signals, like voltage or current) into analog signals.

( DAC एक ऐसी device है जो digital signal को analog signal जैसे voltage या current convert करता है। )

Why it's important:

Some output devices (like analog actuators, analog meters, or motors) need analog input. DAC is required to drive them.

(इस output devices जैसे analog actuators, motor से control होता है जो DAC चाहिए होता है।)

How it works:

- The controller sends a digital number (e.g., 0-255).
- DAC translates it into a corresponding analog voltage (e.g., 0-5V).
- (controller digital value होता है जैसे 0-255)
- DAC इनको analog voltage में convert करता है जैसे 0-5V.)

Real life example:-

PLC और servo motor की speed को vary करता चुकता है जो DAC से analog voltage देकर control करता है।

use:- Industrial drives, audio systems, process automation.

2. Motors - DC motor, Synchronous motor, Servo motor.

### \* DC Motor :

A DC motor operates using Direct current (DC) and allows easy speed control by varying the supply voltage or current.

(DC motor एक ऐसा motor होता है जो Direct current से operate करता है। इसकी speed voltage या current से easily control होती है।)

### Working principle:

When a conductor carrying current is placed in a magnetic field, a force is generated, which produces torque and rotates the shaft.

(जब conductor magnetic field में current carry करता है तो force लोंगी है और rotor घुमती है। ये force torque produce करती है।)

### Main components:

- **Stator**: The stationary part of the motor, often containing permanent magnets or electromagnets that creates a magnetic field.
- **Rotor (Armature)**: The rotating part of motor, consisting of coils of wire wound around an iron core.

• **Commutator:** The rotating switch that directs current to the armature coils in a specific sequence, ensuring continuous rotation.

• **Brushes:** carry current from external circuit to the armature.

**Step-by-step working:**

- Dc supply is given to the armature winding.
- current flows through the conductor placed in magnetic field.
- A force (torque) is generated as per Fleming's rule.
- Armature starts rotating.
- commutator changes the current direction every half cycle to maintain continuous rotation.
- Dc supply winding में दिया जाता है।
- current armature winding से flow करता है।
- magnetic field और current के interaction से torque produce होता है।
- Armature rotate करता है और mechanical motion generate होता है।
- commutator हर half-turn में current की direction change करता है ताकि rotation same direction में रहे।

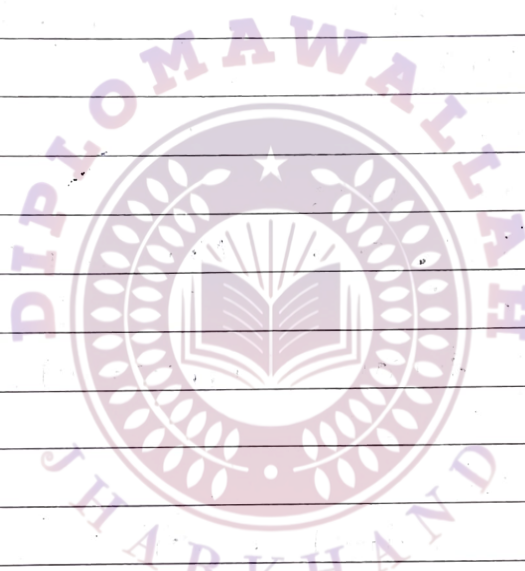


features :

- speed is controlled by voltage.
- Easy to start and stop.
- compact and cost-effective.

examples • electric bicycles

- DC drives in CNC machines
- Small packaging conveyors.



### \* Synchronous Motor :

A synchronous motor is an AC motor in which the rotor rotates in synchronization with the stator's magnetic field, at constant speed.

(यह AC motor होता है जिसमें 'rotor stator के rotating magnetic field के साथ exact same speed पर घूमता है।)

## Working principle:

AC supply creates a rotating magnetic field in the stator. Rotor poles lock with this field and rotate at the same frequency without slip.

(AC supply stator में rotating magnetic field बनाता है। Rotor के poles इस magnetic field के साथ synchronize हो जाते हैं और same speed से rotate करते हैं।)

## Key features:-

- constant speed (no variation with load)
- slip = 0
- High torque efficiency

## Examples:-

- cement industry में crushers के लिए।
- Textile looms
- Power factor correction (Synchronous condensers)

\* Servo motor :

A Servo motor is a closed-loop motor in which both speed and position are controlled accurately. It includes a feedback device such as encoder, which provides the exact current position of the motor shaft.

( Servo motor एक closed-loop motor है जिसमें speed और position दोनों का control किया जाता है। इसमें feedback device होता है जैसे encoder जो exact position बताता है। )

Working:

The controller sends the desired position or angle to the servo motor. The encoder provides feedback about the actual position. The motor then automatically adjusts itself to match the actual position with the desired one by correcting any error.

( controller desired position देता है, encoder actual position बताता है, और motor अपने-आप adjust होता है। )

Features:-

- Very accurate
- Fast response
- works well for automation tasks

Applications:-

Robots in automobile manufacturing, CNC machines tools

## 3. Induction Motor and Stepper Motor:

### \* Induction Motor:-

An induction motor is an AC motor that operates on the principle of electromagnetic induction, where current is induced in the rotor without physical connection.

(Induction motor एक AC motor होता है जो electromagnetic induction के principle पर काम करता है। इसका सबसे बड़ा feature है कि rotor में direct electrical connection नहीं होता, current उसे से induce होता है।)

### How it works:

- When 3-phase AC power is supplied to the stator, a rotating magnetic field is created.
- This field cuts across the rotor, inducing current (by Faraday's Law).
- The interaction b/w this current and the magnetic field produces torque, rotating the rotor.

- (Stator में जब 3-phase AC supply दिया जाता है तो एक rotating magnetic field बनता है।)
- (यह field rotor के पास से cut होता है, जिससे rotor में current induce होता है।)
- Induced current और magnetic field के interaction से torque बनता है और rotor घूमता है।)

Features :-

- Simple design
- Low maintenance
- Inexpensive
- Some slip b/w rotor and stator speed

Application:-

Water pumps  
Industrial blowers  
Assembly line conveyors

\* Stepper motor :

A stepper motor is a special electric motor that moves in small, precise steps instead of continuous rotation. Each input pulse moves the motor a fixed angle.

(Stepper motor एक special motor है जो discrete steps में rotate करती है। हर signal के साथ motor fixed angle से घूमती है।)

How it works:-

- It contains multiple coils (electromagnets).
- A controller energizes these coils in a specific sequence.
- Each pulse causes the motor to rotate a specific angle (like  $1.8^\circ$  per step).
- The total position is controlled by the number of pulses sent.

- (इसमें multiple electromagnets होते हैं।)
- (controller इन electromagnet को एक specific order में energize करता है।)
- इन energize होने पर motor एक step घूमता है (जैसे  $1.8^\circ$  per step)।
- इससे position बहुत accurately control की जा सकती है।

Features:-

- Excellent position control
- No feedback required (open-loop)
- Holds position when not moving.

Applications:-

- 3D printing and laser cutting
- Automated sewing machines
- Robotics for precise movement.