Unit 4: Assignment

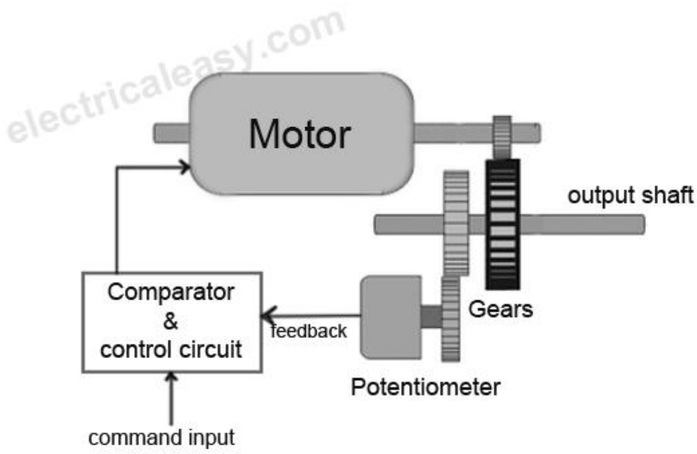
1. **What is the difference between AC servo motor and DC servo motor?**

AC Servo Motor	**DC Servo Motor**
Operates on AC power supply (alternating current).	Operates on DC power supply (direct current).
Uses AC synchronous or induction motors for precision control.	Uses DC motors, typically a permanent magnet or wound field motor.
Stator creates a rotating magnetic field and rotor follows it.	Rotor rotates due to the magnetic field generated by the stator and brushes.
Requires feedback system (e.g., encoder) for position and speed control.	Uses commutators and brushes for rotation control, providing smoother operation in lower-speed applications.
Higher power and efficiency at higher speeds.	Better torque at low speeds.
Preferred for higher precision and high-performance applications.	Used in lower-cost and simple applications.

2. Explain the construction and working principle of a DC servo motor with diagram and Applications.

Construction:

- **Stator**: The stator consists of a permanent magnet or field windings that produce a stationary magnetic field.
- **Rotor (Armature)**: The rotor is a coil of wire that rotates inside the magnetic field. The armature is connected to a shaft.
- **Commutator and Brushes**: These are used to reverse the direction of current in the rotor windings, ensuring continuous rotation.



Working Principle:

- A DC supply is given to the stator.

- The current in the armature winding creates a magnetic field that interacts with the stator field, resulting in torque and causing the rotor to turn.
- The commutator reverses the current in the windings as the rotor turns, maintaining continuous motion.
- The feedback system ensures precise positioning and speed control.

Applications:

- Robotic arms, automated control systems, servo-controlled mechanisms, and precision positioning systems.

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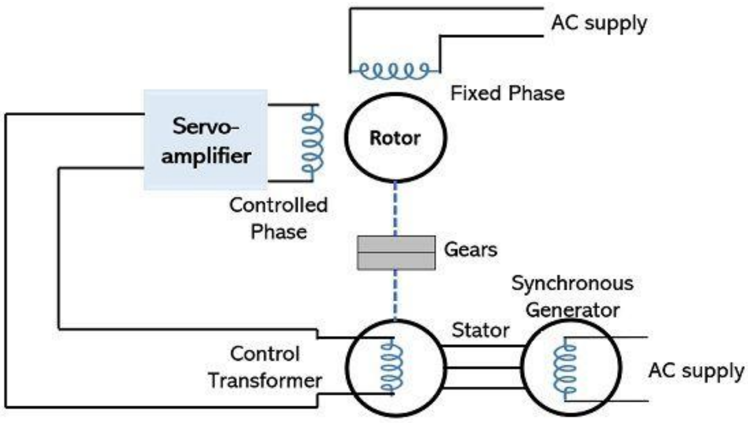
3. Explain the construction and working principle of an AC servo motor with diagram and Applications.

Construction:

- **Stator**: The stator has **two windings**: a **main winding** powered by a constant AC supply, and a **control winding** powered by a variable voltage to control the rotor's position.
- **Rotor**: The rotor may be either a **squirrel-cage** or **drag cup** type, both made of conducting material that interacts with the stator's magnetic field.



Schematic of Servo System

Working Principle:

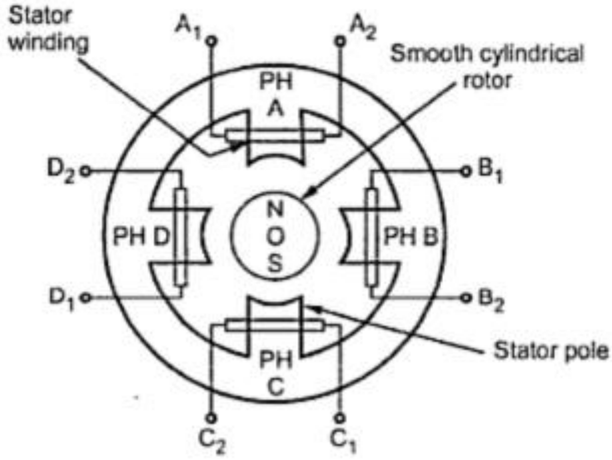
- The **main winding** produces a **constant magnetic field**.
- The **control winding** produces a **rotating magnetic field** due to the variable voltage supplied to it.
- The **rotor** follows the rotating field and **aligns** itself with the changing field, causing it to rotate.
- The position of the rotor is continuously adjusted based on the error signal from the feedback system, ensuring precise control.

Applications:

- **Robotics**, **CNC machinery**, **automation systems**, and **high-precision control applications**.

4. Explain the construction and working of a permanent magnet type stepper motor with diagram and Applications.

Construction:



- **Stator**: The stator has **electromagnetic coils** wound around it to create a magnetic field.
- **Rotor**: The rotor is a **permanent magnet** that interacts with the stator's magnetic field.
- **No Brushes**: There are no brushes, as the rotor is moved by a step-by-step change in the magnetic field of the stator.

Working Principle:

- The **stator coils** are energized in sequence, generating a **magnetic field** that attracts or repels the rotor's permanent magnet.
- The rotor **rotates step by step** as each coil is energized, aligning with the magnetic field of the activated stator coil.
- **Full rotation** is achieved through the sequential energizing of coils, which ensures precise control.

Applications:

- **Printers**, **discs drives**, **scanners**, **robotics**, and **precision positioning systems**.

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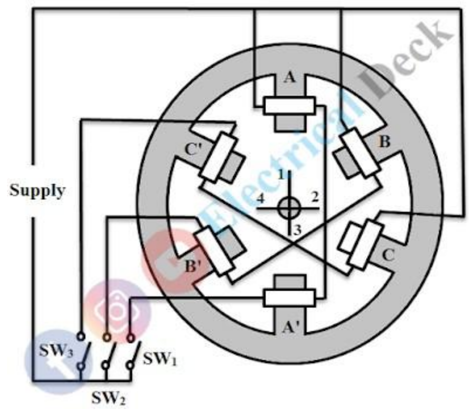
5. Explain the construction and working of Variable reluctance type stepper motor with diagram and Applications.

Construction:



- **Stator**: The stator has **electromagnetic coils** wound around it to produce a magnetic field.
- **Rotor**: The rotor is made of **soft iron** and has multiple **teeth**.
- **No permanent magnets**: The rotor relies on the **magnetic reluctance** principle.

Working Principle:

- The **energized stator coils** generate a magnetic field that **attracts the rotor's teeth**.

- The rotor moves to the position where the reluctance is minimized (where the teeth of the rotor align with the magnetic field).
- The rotor moves step by step as coils are energized sequentially.
- The rotor's movement is determined by the **minimization of reluctance**.

Applications:

- **Computer disk drives**, **positioning systems**, **industrial automation**, and **low-cost motion control systems**.

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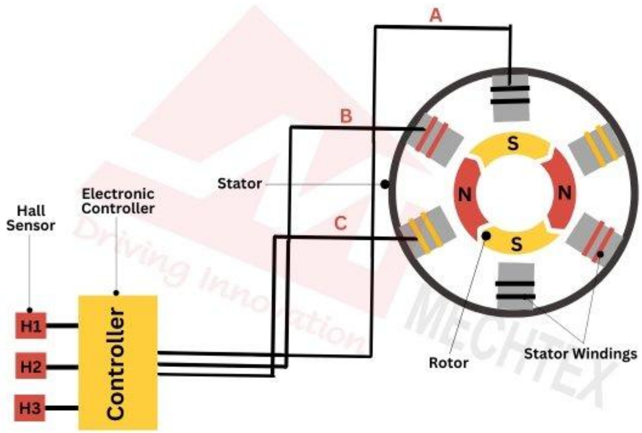
6. Explain the construction and working principle of a BLDC motor with diagram and Applications.

Construction:

- **Stator**: The stator has **three-phase windings** wound on a laminated core.
- **Rotor**: The rotor is made of **permanent magnets**.
- **No Brushes**: There are no brushes for commutation, and **electronic commutation** is used instead.



Working Principle:

- The **stator windings** are powered by **three-phase AC** current, creating a rotating magnetic field.
- The **rotor**, made of permanent magnets, follows the magnetic field of the stator.
- The position of the rotor is continuously sensed by a **Hall effect sensor**, and the **electronic controller** switches the current to the stator windings at the appropriate time to keep the rotor turning.
- The motor operates efficiently without the friction caused by brushes.

Applications:

- **Electric vehicles**, **drone motors**, **fans**, **computer cooling fans**, and **industrial machinery**.