# SNS COLLEGE OF TECHNOLOGY

**(An Autonomous Institution)**

**COIMBATORE-35.**

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A++' Grade

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai.

## DEPARTMENT OF AUTOMOBILE ENGINEERING

**COURSE NAME : 19AUB204 – AUTOMOTIVE ELECTRICAL AND ELECTRONICS ENGINEERING**

II YEAR / IV SEMESTER

Unit 4 – Sensors and Actuators

Topic : Stepper Motor

# STEPPER MOTOR

- A stepper motor is a type of brushless DC electric motor that divides a full rotation into a number of equal steps.
- Unlike traditional motors, which rotate continuously, stepper motors rotate in discrete steps, allowing for precise control of angular position.
- Stepper motors can achieve precise positioning and repeatability of movement due to their design.
- They can be operated without feedback control systems (closed-loop), which simplifies the control and reduces system cost.
- They provide high torque at low speeds, which is useful for applications requiring low-speed and high-torque performance.

# COMPONENTS

## ➢ Rotor

- ❖ **Permanent Magnet Rotor**: In permanent magnet stepper motors, the rotor is made of a permanent magnet that interacts with the magnetic fields generated by the stator windings.
- ❖ **Variable Reluctance Rotor**: In variable reluctance stepper motors, the rotor is made of soft iron and has teeth that align with the magnetic field to minimize reluctance.
- ❖ **Hybrid Rotor**: In hybrid stepper motors, the rotor combines features of both permanent magnet and variable reluctance types, typically incorporating teeth on a magnetized rotor to enhance performance.

# COMPONENTS

- **Stator**
  - The stator is the stationary part of the motor that surrounds the rotor. It contains several windings (coils) that are energized in a specific sequence to create a rotating magnetic field.
  - **Winding Coils**: Electromagnetic coils that generate magnetic fields when current passes through them. The arrangement and number of these coils determine the step angle and resolution of the motor.
  - **Poles**: The stator has multiple poles, each containing windings, which interact with the rotor to produce motion.

# COMPONENTS

- **Bearings:** Bearings support the rotor and allow it to rotate smoothly with minimal friction. High-quality bearings are crucial for the motor's longevity and performance.
- **Shaft:** The shaft is connected to the rotor and extends out of the motor. It transmits the rotational motion to the load or the device that the motor is driving.
- **Housing:** The housing encases all the internal components of the stepper motor, providing protection and structural support. It also helps in heat dissipation to prevent overheating.

# WORKING

- Stepper motors operate based on the principle of electromagnetism.
- Their working involves converting electrical pulses into discrete rotational steps, allowing precise control over the motor's position, speed, and acceleration
- Stepper motors have a rotor (either a permanent magnet or a soft iron core) and a stator with multiple windings.
- When electrical current flows through these windings, it generates magnetic fields.
- By sequentially energizing the stator windings, a rotating magnetic field is produced.
- The rotor aligns itself with this rotating field, causing it to rotate in discrete steps.

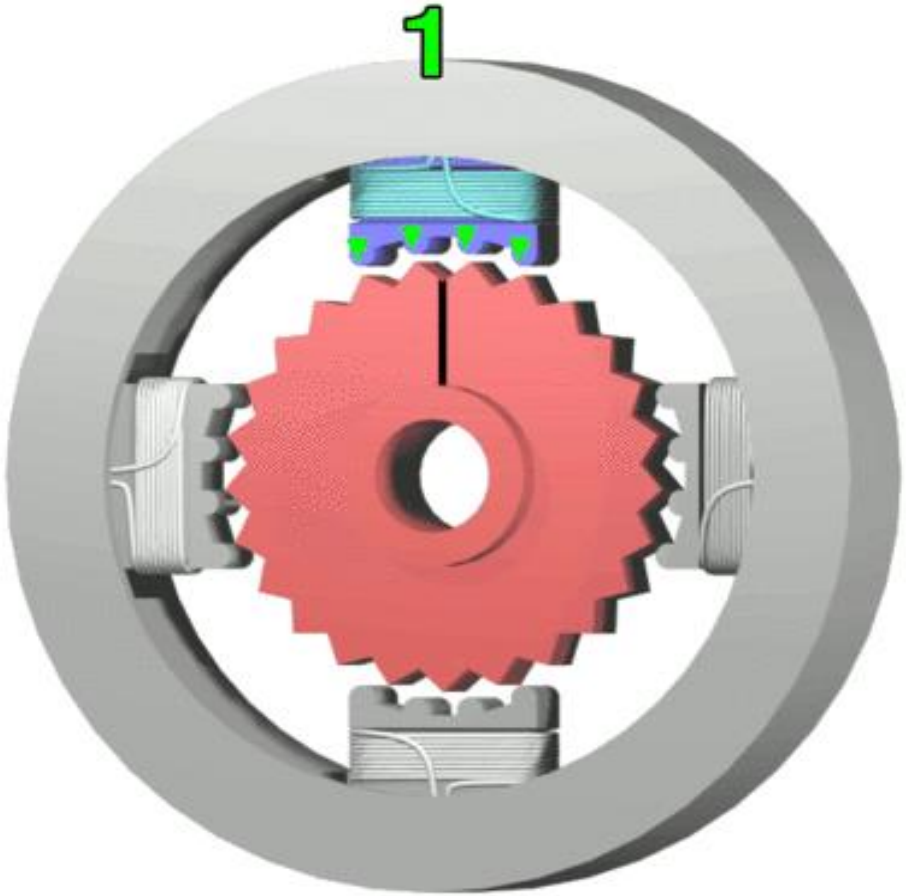
# WORKING

- The rotor starts in a specific initial position, aligned with one of the stator's magnetic fields.
- An electrical pulse is sent to the stepper motor driver, which energizes a particular winding or set of windings in the stator.
- The energized winding creates a magnetic field that interacts with the rotor’s magnetic field, causing the rotor to move to align with the new magnetic field.
- This movement constitutes one step.
- Another pulse is sent, energizing the next winding or combination of windings in the sequence.

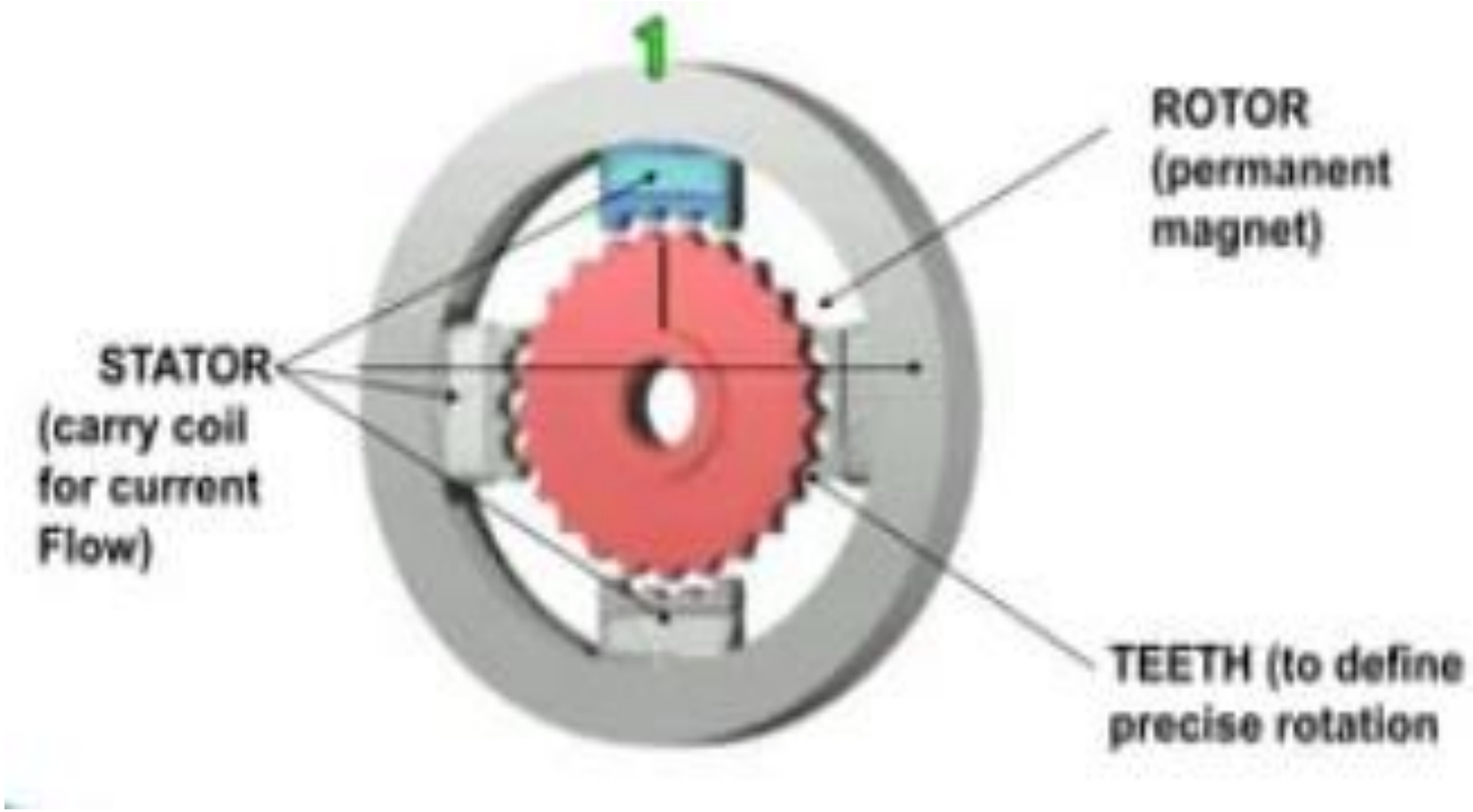
# WORKING

- The rotor moves again to align with the new field.
- This process is repeated, with each pulse causing the rotor to move one step.
- By controlling the sequence and timing of pulses, precise control over the rotor's position and speed is achieved.

# WORKING



# WORKING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ROTOR
(permanent
magnet)
STATOR
(carry coil
for current
Flow)
TEETH (to define
precise rotation

# ADVANTAGES AND DISADVANTAGES

## ADVANTAGES

- Precise positioning without feedback systems.
- High torque at low speeds.
- Simple and robust control systems.

## DISADVANTAGES

- Resonance issues at certain speeds.
- Reduced torque at higher speeds.
- Power consumption can be high, especially when holding position.

# APPLICATIONS

- 3D Printers
- CNC Machines
- Robotics
- Camera Platforms
- Medical Equipment

# THANK YOU !!!