# SNS COLLEGE OF TECHNOLOGY

**Coimbatore-35**
**An Autonomous Institution**

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

## DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

## 19ECT201 – ELECTRICAL ENGINEERING & INSTRUMENTATION

II YEAR III SEM

UNIT 3 – INDUCTION MACHINES

TOPIC 2- Three phase induction motor

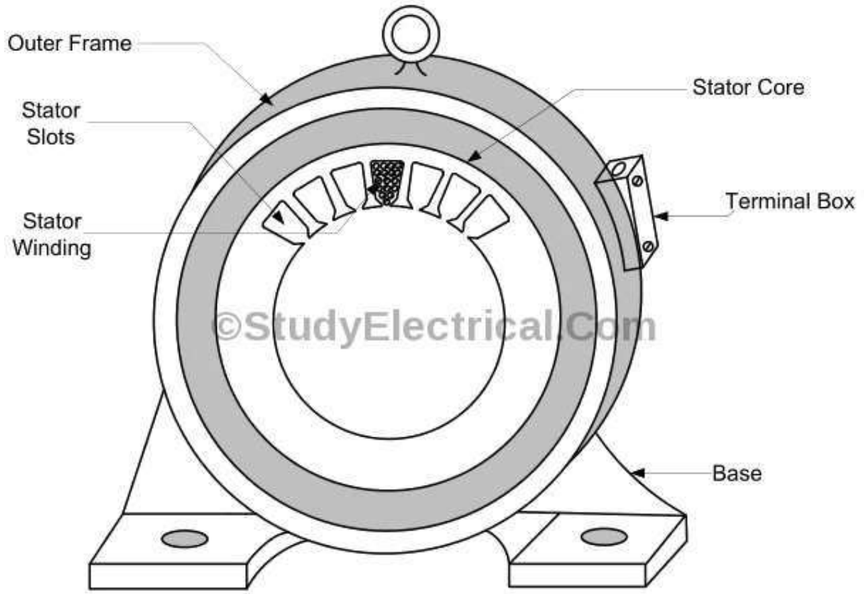
# Three Phase Induction Motor

- The three-phase induction motors are the most widely used electric motors in the industry.
- They work on the principle of electromagnetic induction.
- Due to the similarity in the working principle of the transformer, it is also known as the **rotating transformer**.
- They run at essentially constant speed from no load to full load.
- However, the speed is frequency-dependent and consequently, these motors are **easily adapted to speed control**.
- We usually prefer DC motors when large speed variations are required

# Three phase Induction motor Construction

## Stator:

- The stator consists of a steel frame that encloses a hollow, cylindrical core made up of thin laminations of silicon steel to reduce hysteresis and eddy current losses.
- A number of evenly spaced slots are provided on the inner periphery of the laminations.
- The insulated conductors are connected to form a balanced 3-phase star or delta connected circuit.



# Three phase Induction motor Construction

## Rotor:

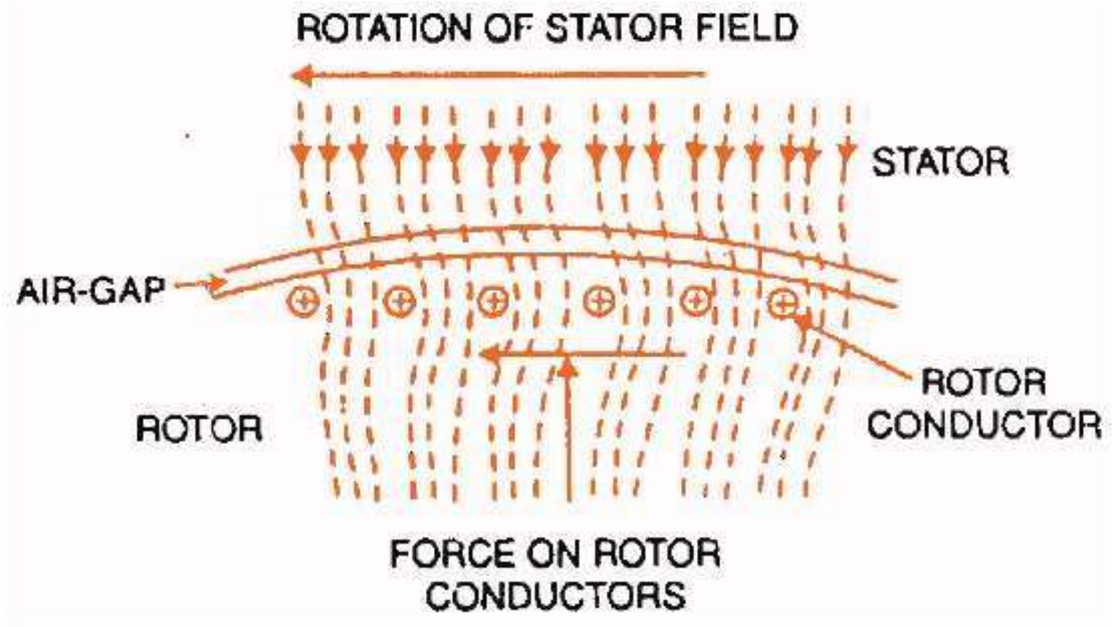
The rotor, mounted on a shaft, is a hollow laminated core having slots on its outer periphery.

The winding placed in these slots (called rotor winding) may be one of the following two types:

- Squirrel Cage Type
- Wound Rotor Type

# Working Principle of 3 phase Induction motor

- The working of the three-phase induction motor is based on the principle of electromagnetic induction.
- When three-phase stator winding of an induction motor is energized from a 3 phase supply, a **rotating magnetic field** is set up which rotates around the stator at synchronous speed ($N_s$).




*A portion of rotating magnetic field in a three-phase induction motor*

# Working- Three phase Induction motor

- The rotating field passes through the air gap and cuts the rotor conductors, which are stationary.
- An EMF gets induced in every rotor conductor due to the relative speed between the rotating magnetic flux and the stationary rotor
- The current-carrying rotor conductors are placed in the magnetic field produced by the stator.
- Consequently, a **mechanical force** acts on the rotor conductors. The sum of the mechanical forces on all the rotor conductors produces a **torque** which tends to move the rotor in the same direction as the rotating field.
- The fact that the rotor is urged to follow the stator field (i.e., rotor moves in the direction of stator field) can be explained by **Lenz's law**.

# Applications of Three Phase Induction motor

- They are used for loads that requires speed control.

- Typical applications of wound rotor or slip ring induction motors are **crushers, plunger pumps, cranes & hoists, elevators, compressors and conveyors**

# Slip in Induction motor

- In practice, the rotor can never reach the speed of stator flux.
- The friction and windage would immediately cause the rotor to slow down.
- Hence, the rotor speed (N) is always less than the stator field speed ($N_s$). This difference in speed depends upon load on the motor.
- The difference between the synchronous speed $N_s$ of the rotating stator field and the actual rotor speed N is called **slip in a three-phase induction motor**.
- Slip is usually expressed as a percentage of synchronous speed i.e.,
- **Slip, $s = (N_s - N)/N_s \times 100$ %**
- The quantity N s – N is sometimes called **slip speed**.
- When the rotor is stationary (i.e., N = 0), slip, s = 1 or 100 %.

# Starting Methods of Induction Motor

- A three-phase Induction Motor is **Self Starting**.
- When the supply is connected to the stator of a three-phase induction motor, a rotating magnetic field is produced, and the rotor begins rotating and the induction motor starts.
- At the time of starting, the motor slip is **unity**, and the starting current is very large.

The purpose of a starter is not to just start the motor, but it performs the two main functions. They are as follows:

To reduce the heavy starting current,

To provide overload and under-voltage protection.

# Starting Methods of Induction Motor

## Direct on-line starter

The direct on-line starter method, of an induction motor, is simple and economical.

In this method, the starter is connected directly to supply voltage.

By this method, small motors up to 5 kW rating are started to avoid the supply voltage fluctuation.

## Star delta starter

The star delta starter method of starting three-phase induction motors is very common and widely used among all the methods.

In this method, the motor runs at delta-connected stator windings.

# Starting Methods of Induction Motor

## Autotransformer starter

- The Autotransformer is used in both types of connections, i.e., either star connected or delta connected.
- The autotransformer is used to limit the starting current of the induction motor.


Thank You