



SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

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



DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

**COURSE NAME : 19EE401 SYNCHRONOUS AND INDUCTION
MACHINES**

II YEAR /IV SEMESTER

Unit 3: INDUCTION MOTOR

Topic 2 : Construction and Working of Induction Motor



Introduction

Three-phase induction motors are the most common and frequently encountered machines in industry

- simple design, rugged, low-price, easy maintenance
- wide range of power ratings: fractional horsepower to 10 MW
- run essentially as constant speed from no-load to full load
- Its speed depends on the frequency of the power source
 - not easy to have variable speed control
 - requires a variable-frequency power-electronic drive for optimal speed control

Construction

- An induction motor has two main parts
 - **a stationary stator**
 - consisting of a steel frame that supports a hollow, cylindrical core
 - core, constructed from stacked laminations, having a number of evenly spaced slots, providing the space for the stator winding





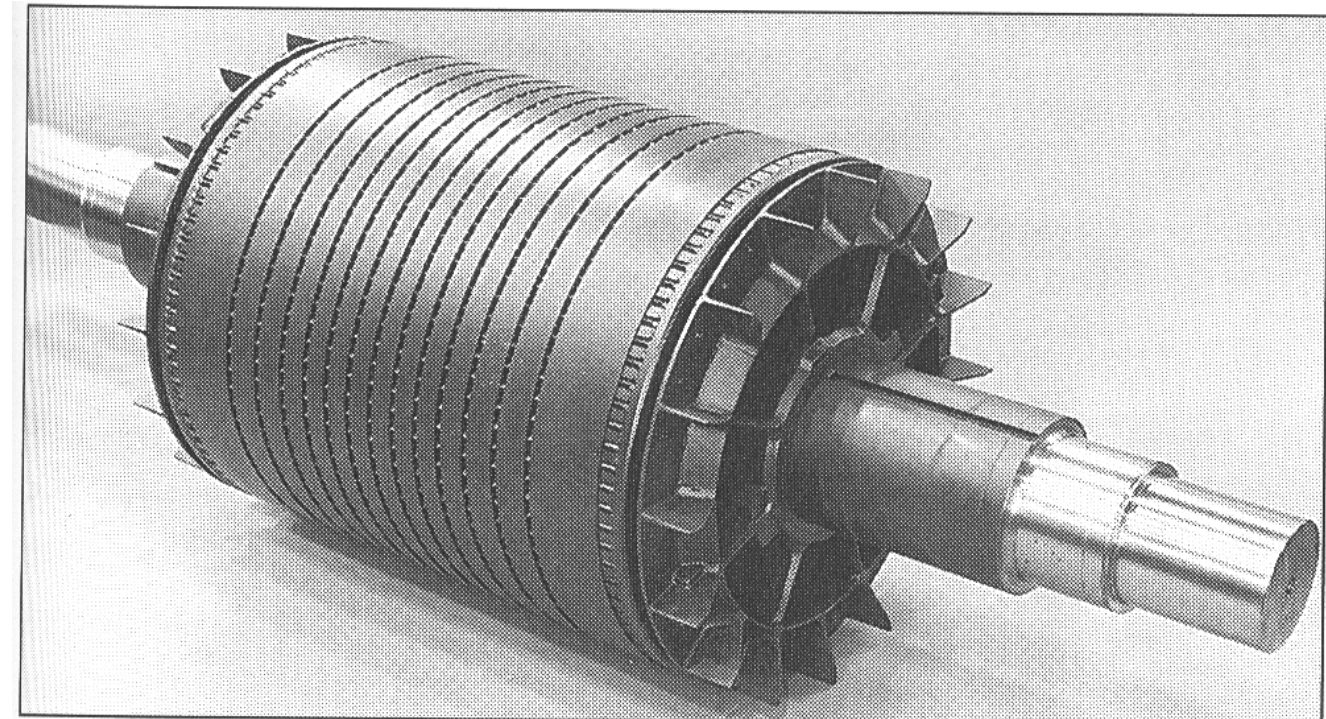
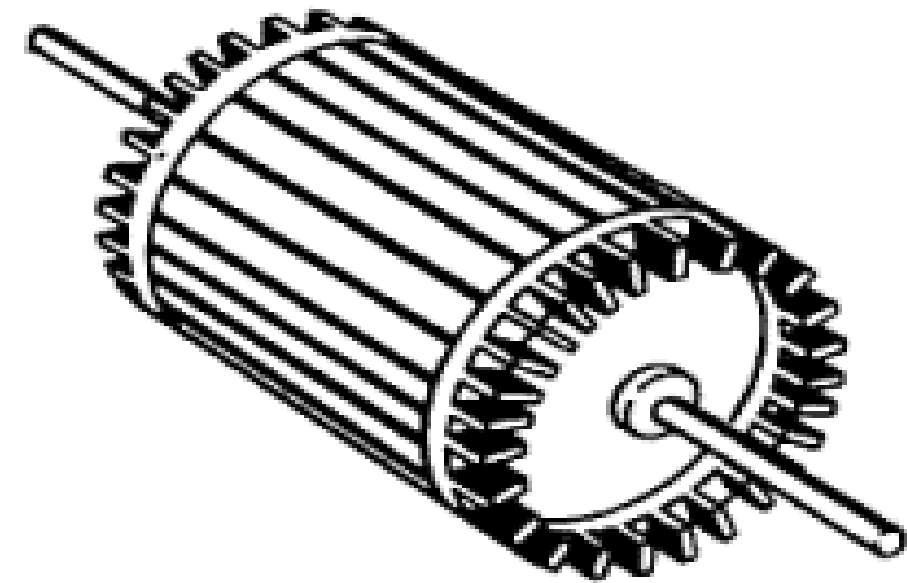
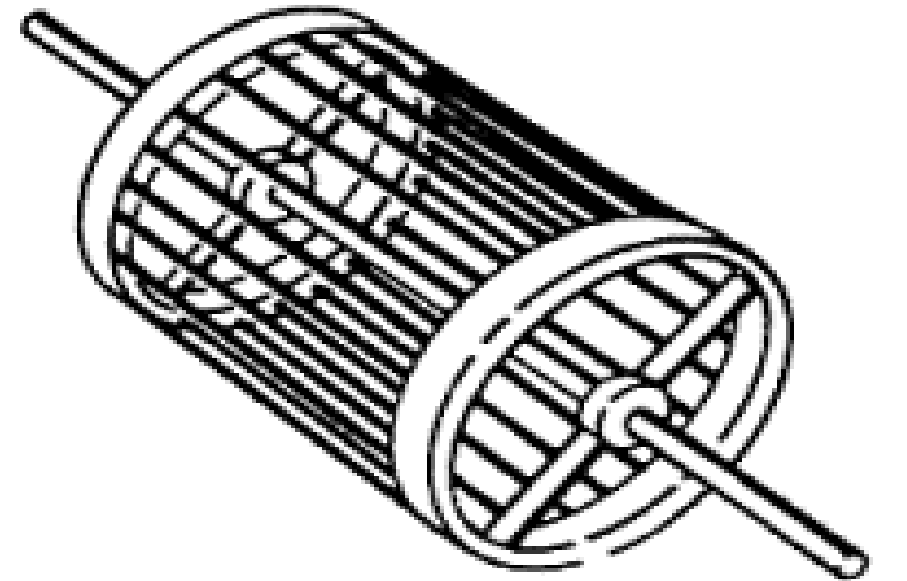
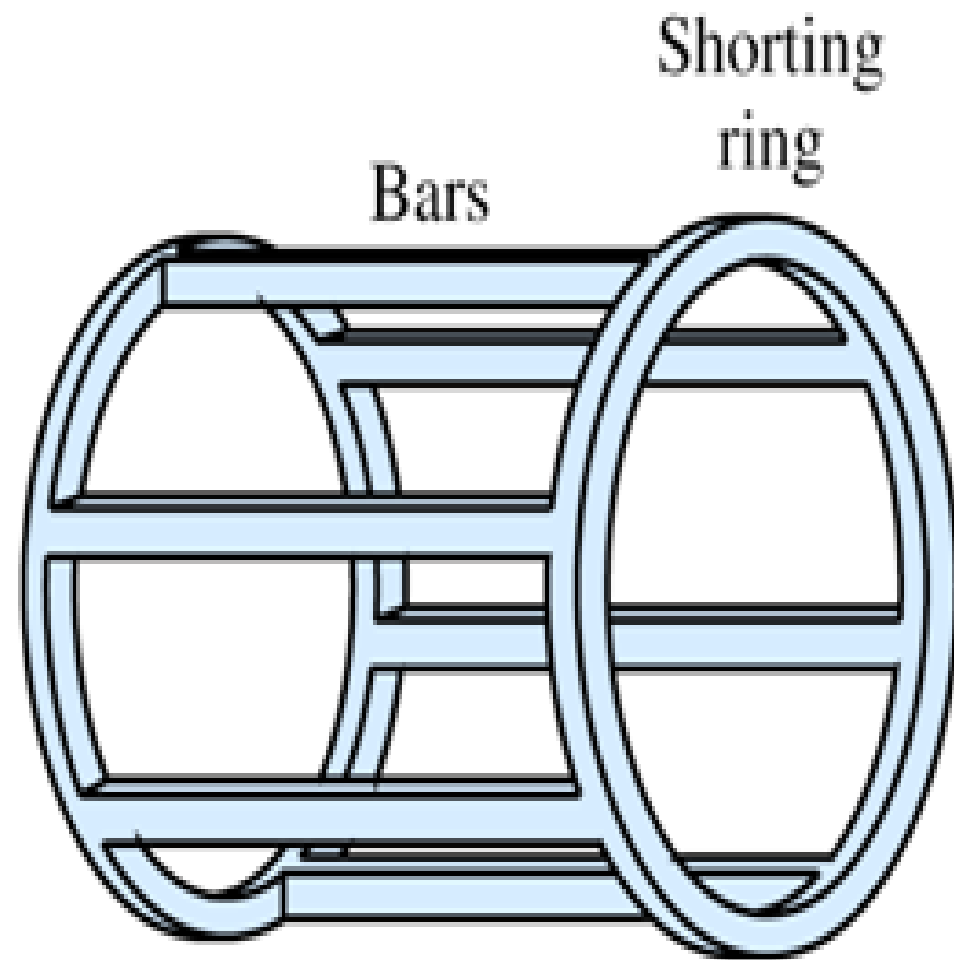
Construction



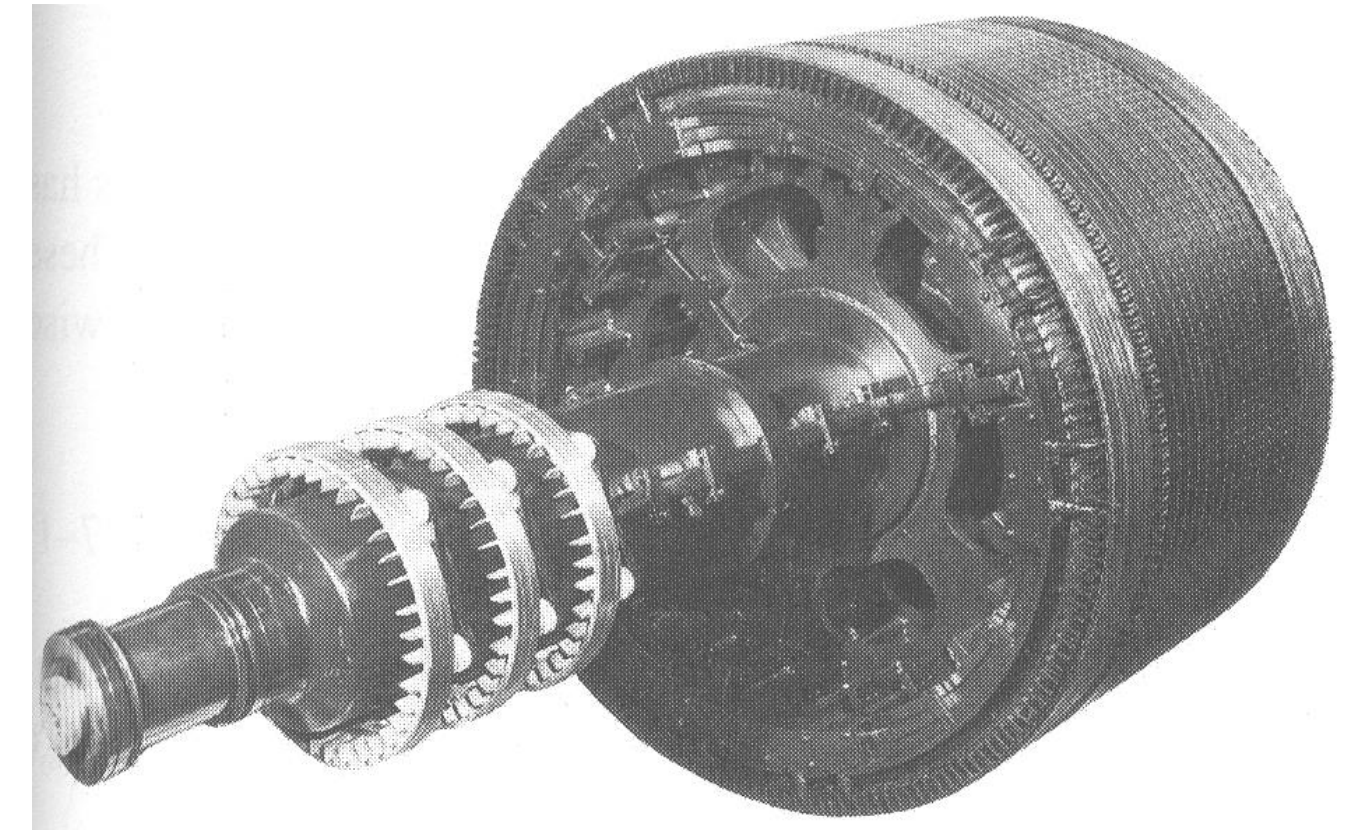
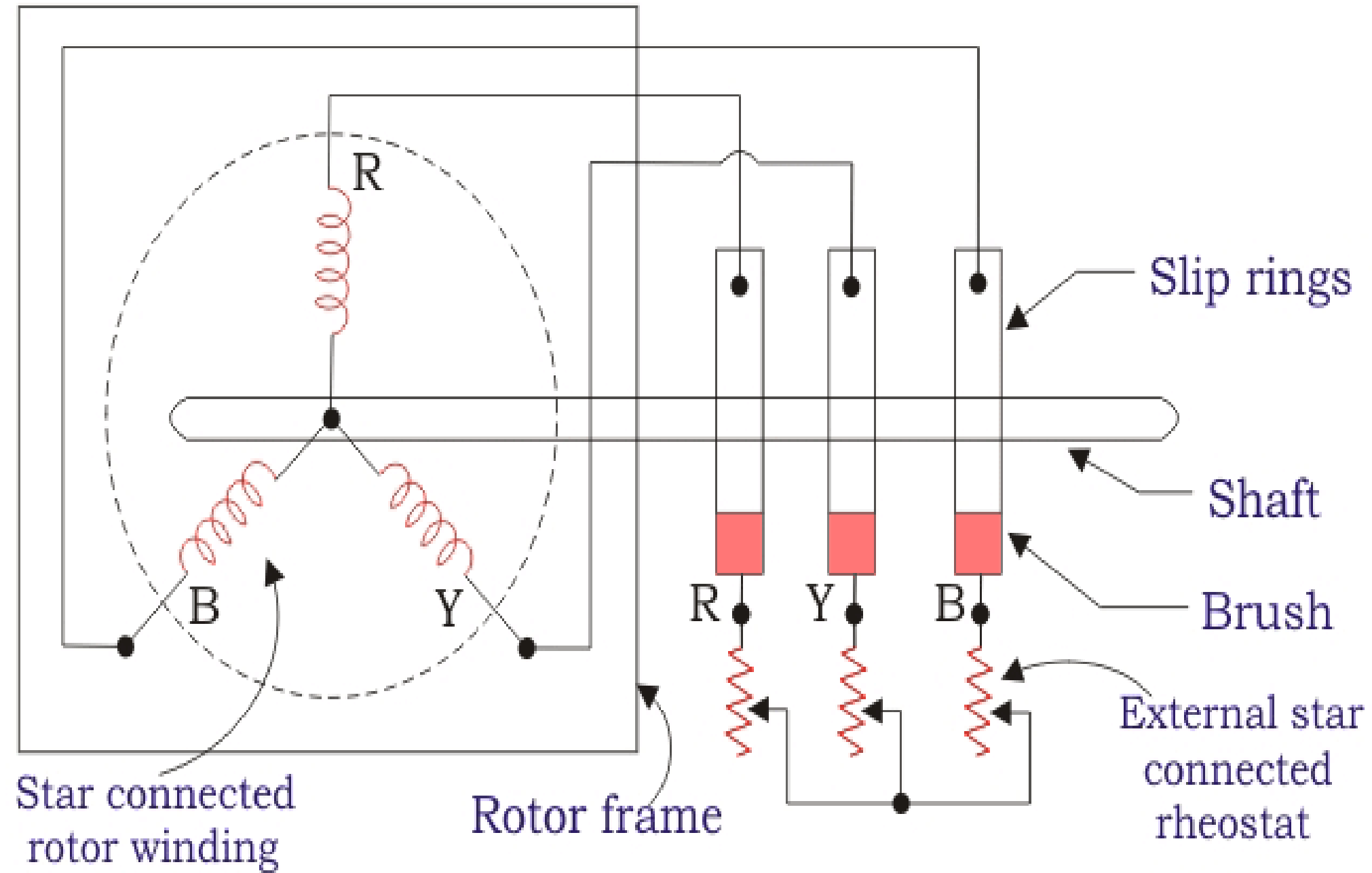
- a revolving rotor

- composed of punched laminations, stacked to create a series of rotor slots, providing space for the rotor winding
- one of two types of rotor windings
- conventional 3-phase windings made of insulated wire (**wound-rotor**) » similar to the winding on the stator
- aluminum bus bars shorted together at the ends by two aluminum rings, forming a squirrel-cage shaped circuit (**squirrel-cage**)
- Two basic design types depending on the rotor design
 - squirrel-cage: conducting bars laid into slots and shorted at both ends by shorting rings.
 - wound-rotor: complete set of three-phase windings exactly as the stator. Usually Y-connected, the ends of the three rotor wires are connected to 3 slip rings on the rotor shaft. In this way, the rotor circuit is accessible.

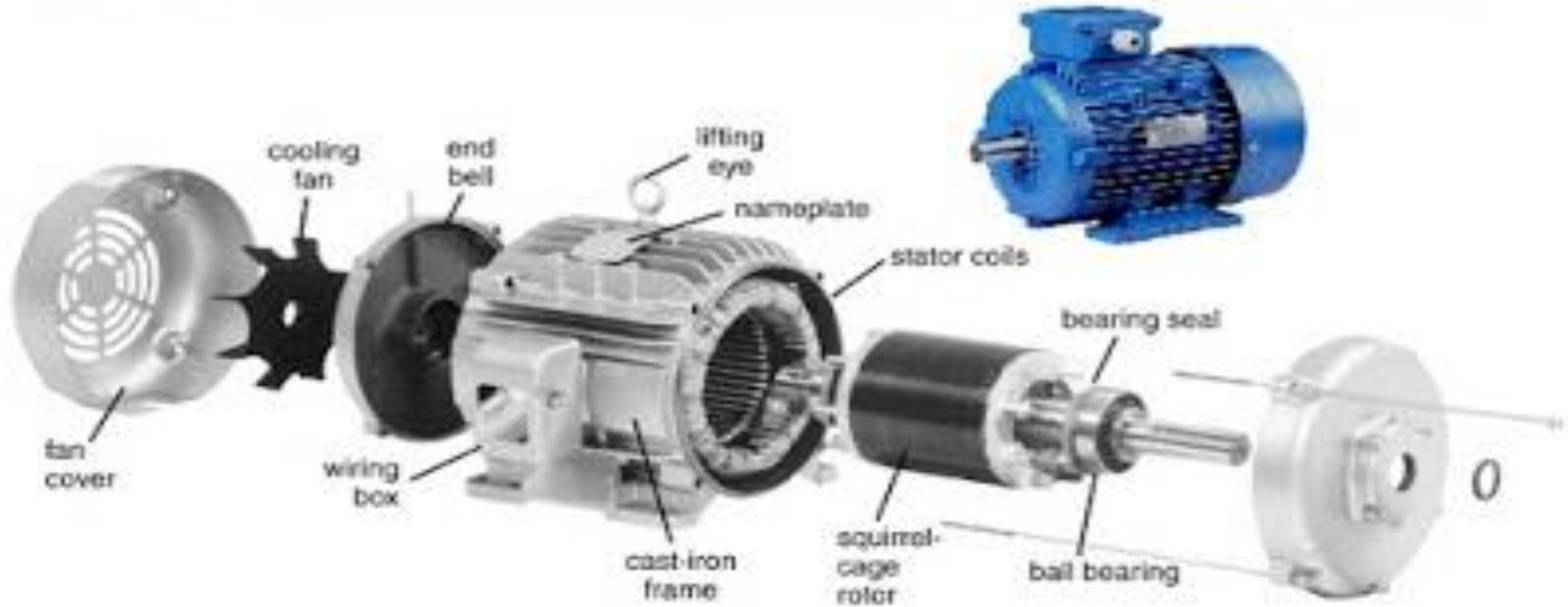
Squirrel Cage Induction Motor



Slip Ring Induction Motor



Induction Motor





Slip ring or phase wound Induction motor

Construction is complicated due to presence of slip ring and brushes.

The rotor winding is similar to the stator winding.

Ease to add rotor resistance by using slip ring and brushes.

Squirrel cage induction motor

Construction is very simple

The rotor consists of rotor bars which are permanently shorted with the help of end rings.

Since the rotor bars are permanently shorted, its not possible to add external resistance.





Slip ring or phase wound Induction motor

Due to presence of external resistance high starting torque can be obtained

Slip ring and brushes are present

Frequent maintenance is required due to presence of brushes

Squirrel cage induction motor

Starting torque is low and cannot be improved

Slip ring and brushes are absent

Less maintenance is required





Slip ring or phase wound Induction motor

The construction is complicated and the presence of brushes and slip ring makes the motor more costly.

This motor is rarely used only 10 % industry uses slip ring induction motor

Squirrel cage induction motor

The construction is simple and robust and it is cheap as compared to slip ring induction motor.

Due to its simple construction and low cost. The squirrel cage induction motor is widely used





Slip ring or phase wound Induction motor

Rotor copper losses are high and hence less efficiency.

Speed control by rotor resistance method is possible.

Slip ring induction motor are used where high starting torque is required i.e in hoists, cranes, elevator etc.

Squirrel cage induction motor

Less rotor copper losses and hence high efficiency.

Speed control by rotor resistance method is not possible.

Squirrel cage induction motor is used in lathes, drilling machine, fan, blower printing machines etc.





Working of Induction Motor



- 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).
- This 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. Since the rotor circuit is short-circuited, currents start flowing in the rotor conductors.
- 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**.



Working of Induction Motor



- The rotor is urged to follow the stator field. According to Lenz's law, the direction of rotor currents will be such that they tend to oppose the cause of producing them.
- Now, the cause producing the rotor currents is the relative speed between the rotating field and the stationary rotor conductors.
- Hence to reduce this relative speed, the rotor starts running in the same direction as that of the stator field and tries to catch it. This is how a three-phase induction motor starts running.



References



1. Kothari, D.P., Nagrath, I.J., “Electric Machines”, McGraw Hill Publishing Company Ltd, 5th Edition, 2017.
2. Murugesh Kumar, K., “Induction and Synchronous machines”, Vikas Publishing House Private Ltd, 2016.

Thank You