3.5 THREE PHASE INDUCTION MOTOR

A **three phase induction motor** runs on a three phase AC supply. **3 phase induction motors** are extensively used for various industrial applications because of their following advantages -

- They have very simple and rugged (almost unbreakable) construction
- they are very reliable and having low cost
- they have high efficiency and good power factor
- minimum maintenance required
- **3 phase induction motor is self-starting** hence extra starting motor or any special starting arrangement is not required

They also have some disadvantages

- speed decreases with increase in load, just like a DC shunt motor
- if speed is to be varied, we have sacrifice some of its efficiency

Construction of A 3 Phase Induction Motor

Just like any other motor, a **3-phase induction motor** also consists of a stator and a rotor. Basically, there are two types of 3 phase IM - 1. **Squirrel cage induction motor** and 2. **Phase Wound induction motor (slip-ring induction motor)**.

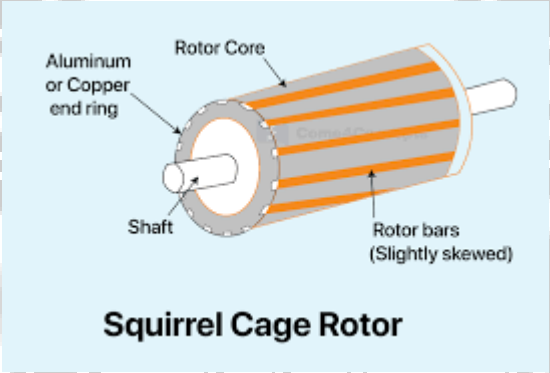
Stator

The stator of a 3 phase IM (Induction Motor) is made up with number of stampings, and these stampings are slotted to receive the stator winding. The stator is wound with a 3-phase winding which is fed from a 3-phase supply. It is wound for a defined number of poles, and the number of poles is determined from the required speed. For greater speed, lesser number of poles is used and vice versa. When stator windings are supplied with 3 phase ac supply, they produce alternating flux which revolves with synchronous speed. The synchronous speed is inversely proportional to number of poles (Ns = 120f / P). This revolving or rotating magnetic flux induces current in rotor windings according to Faraday's law of mutual induction.

Rotor

As described earlier, **rotor of a 3-phase induction motor** can be of either two types, **squirrel cage rotor** and **phase wound rotor** (or simply - wound rotor).

Squirrel Cage Rotor



Most of the induction motors (upto 90%) are of squirrel cage type. **Squirrel cage type rotor** has very simple and almost indestructible construction. This type of rotor consists of a cylindrical laminated core, having parallel slots on it. These parallel slots carry rotor conductors. In this type of rotor, heavy bars of copper, aluminum or alloys are used as rotor conductors instead of wires. Rotor slots are slightly skewed to achieve following advantages -

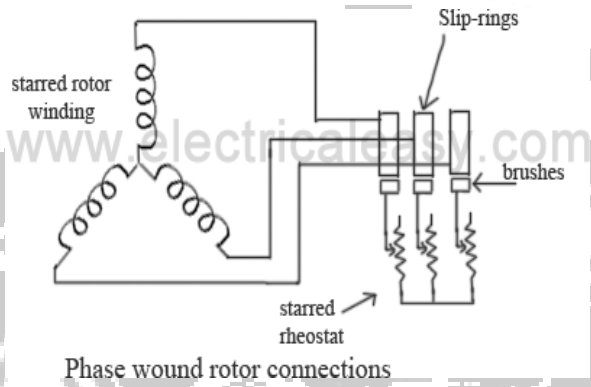
1. it reduces locking tendency of the rotor, i.e. the tendency of rotor teeth to remain under stator teeth due to magnetic attraction.

2. increases the effective transformation ratio between stator and rotor

3. increases rotor resistance due to increased length of the rotor conductor

The rotor bars are brazed or electrically welded to short circuiting end rings at both ends. Thus, this rotor construction looks like a squirrel cage and hence we call it. The rotor bars are permanently short circuited; hence it is not possible to add any external resistance to armature circuit

Phase Wound Rotor



Phase wound rotor connections

Phase wound rotor is wound with 3 phase, double layer, distributed winding. The number of poles of rotor are kept same to the number of poles of the stator. The rotor is always wound 3 phases even if the stator is wound two phases. The three-phase rotor winding is internally star connected. The other three terminals of the winding are taken out via three insulated sleep rings mounted on the shaft and the brushes resting on them. These three brushes are connected to an external star connected rheostat. This arrangement is done to introduce an external resistance in rotor circuit for starting purposes and for changing the speed / torque characteristics. When motor is running at its rated speed, slip rings are automatically short circuited by means of a metal collar and brushes are lifted above the slip rings to minimize the frictional losses.