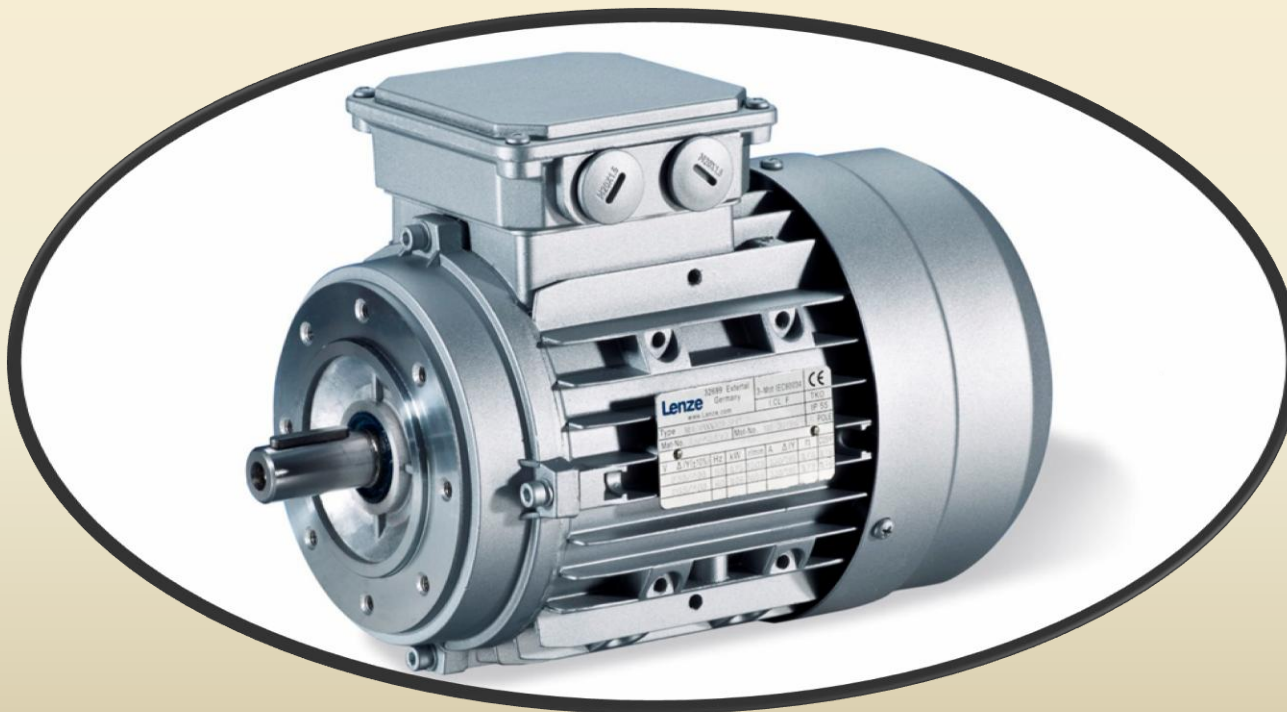




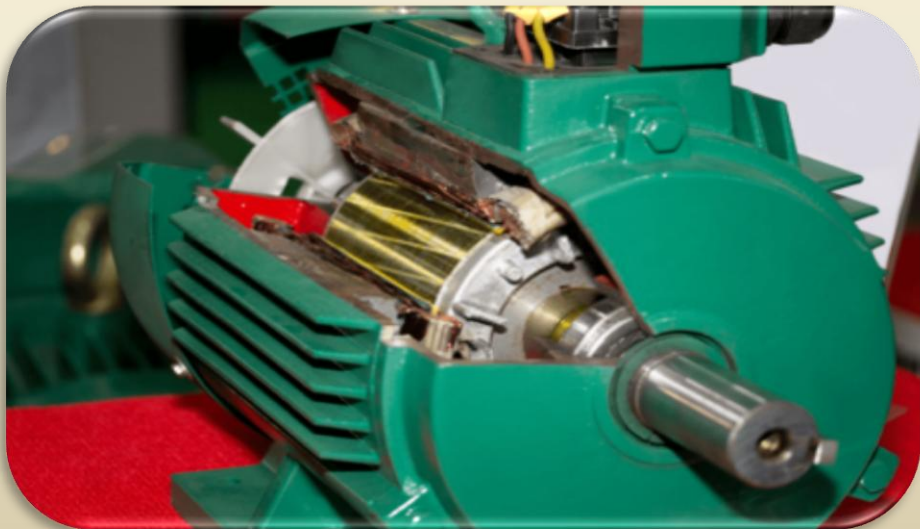
# CONFIGURATION AND CONTROL OF INDUCTION MOTOR DRIVES





Firstly we need to know what is an Induction motor Drive ?

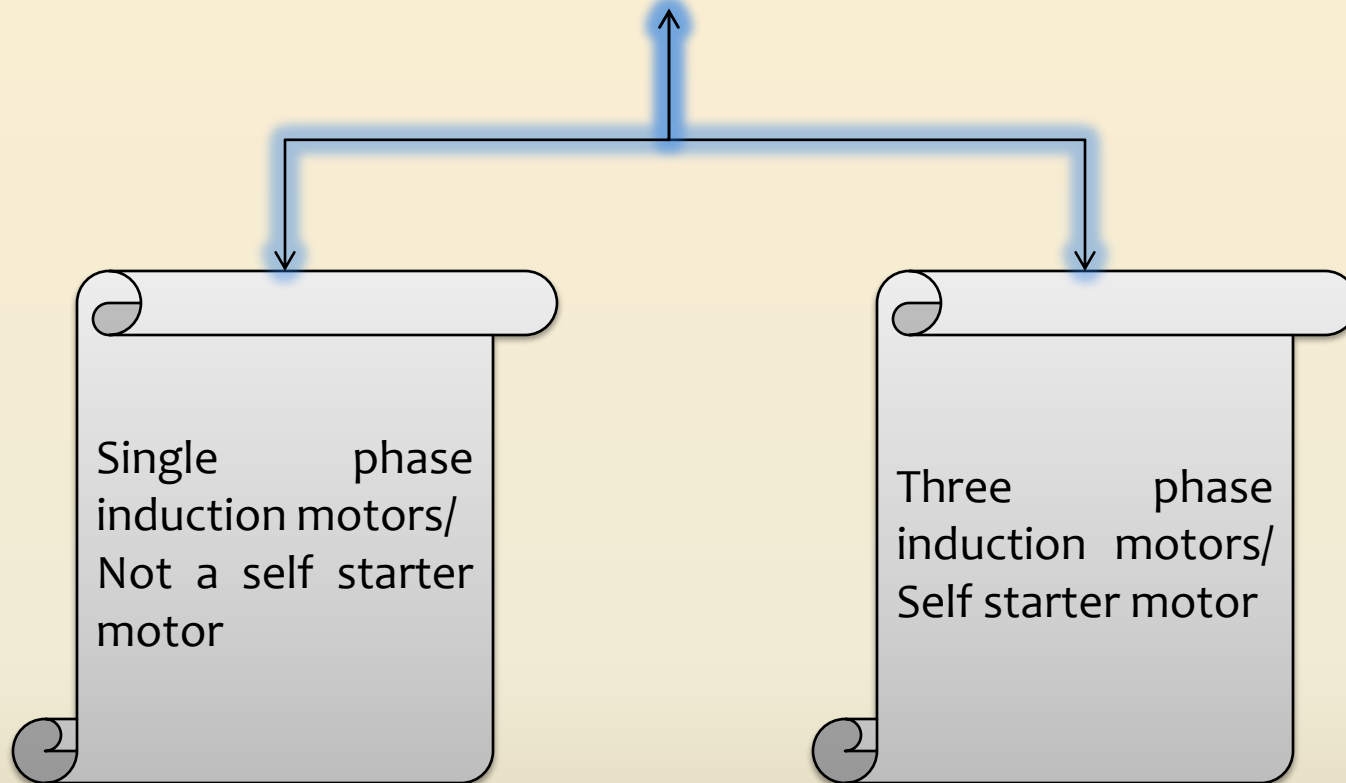
In very simple words induction motors can be described as a three-phase, self-starting constant speed AC motors



The reason for describing induction motors as constant speed is because normally these motors have a constant speed depending on the frequency of the supply and the number of windings.



# WHAT ARE THE TYPES OF INDUCTION MOTOR DRIVES





# Starting of these motors

Star delta starter

Auto-transformers starter

Reactor starter

Saturable reactor starter

Part winding starter

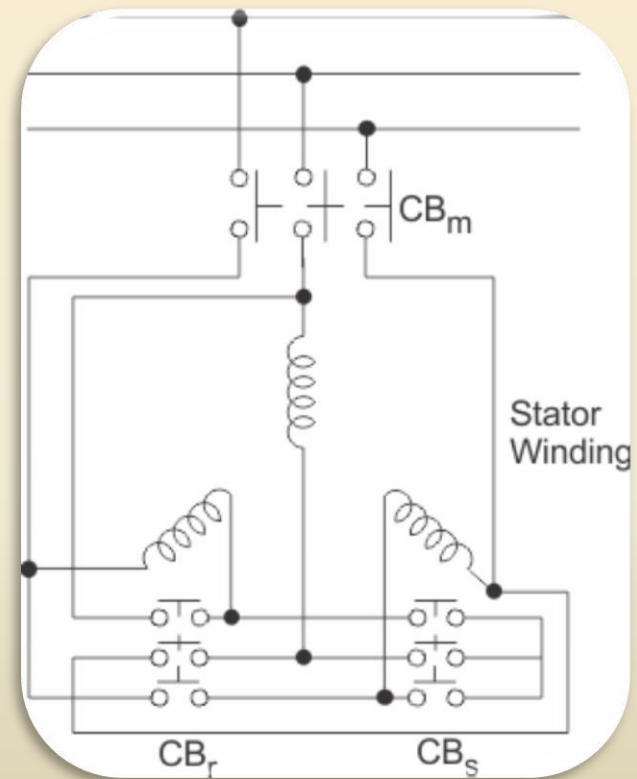
Ac voltage controller starter

Rotor resistance starter.



# Star delta starter

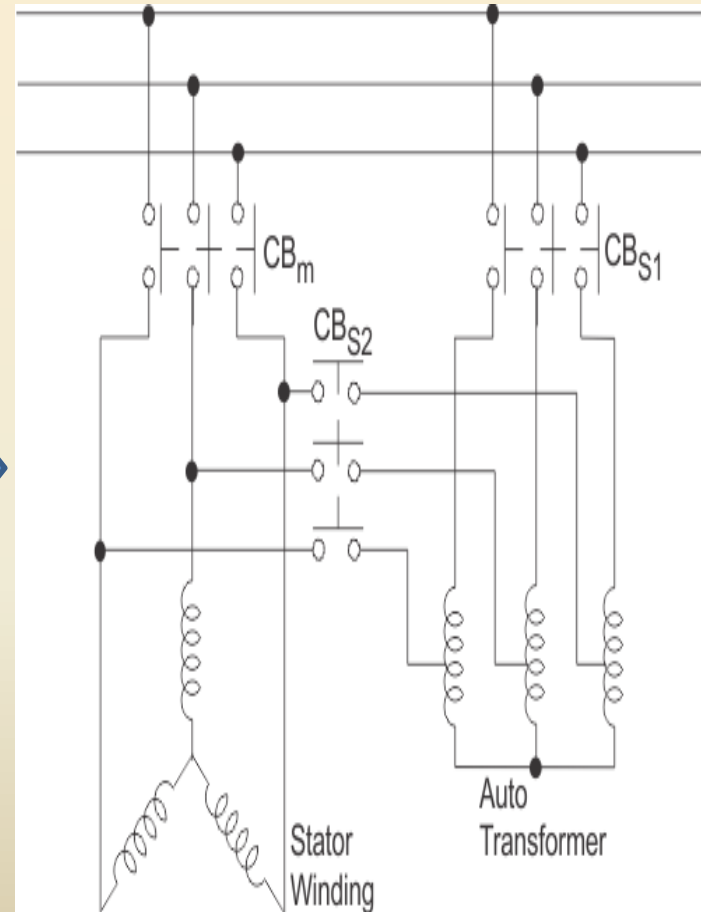
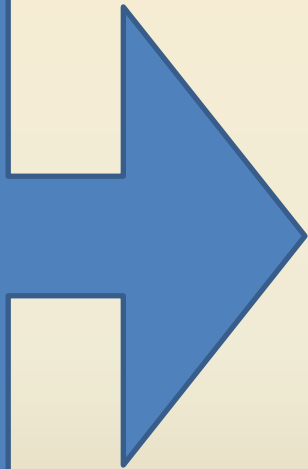
The induction motor drives are normally designed to run on delta connection, but during starting the supply is given from star connection because then the starter voltage and current reduces by  $1/\sqrt{3}$  times than the delta connection. When the motor reaches a steady state speed the connection changes from star to delta connection.





# Auto-transformers starter

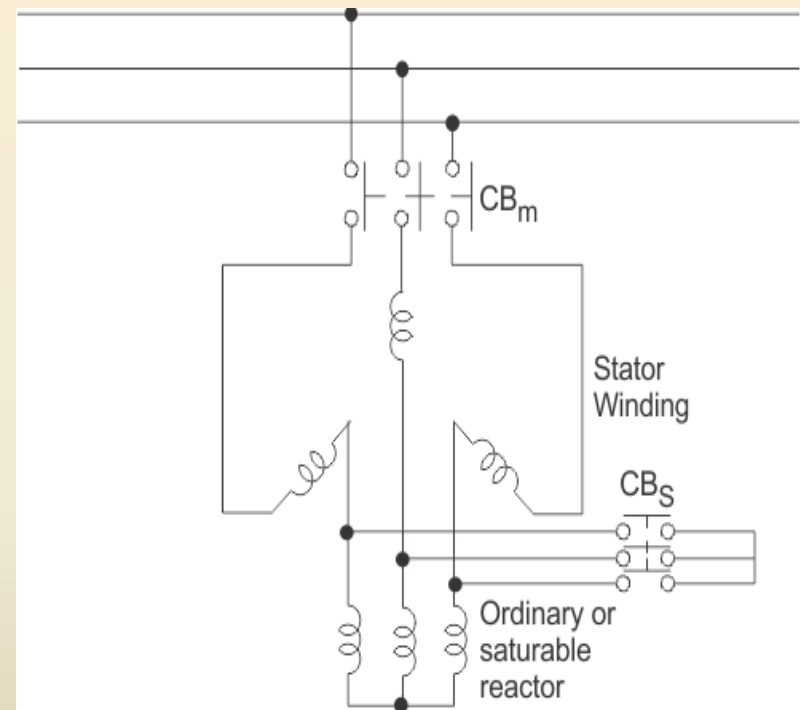
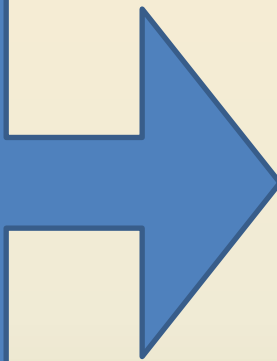
Another type of starting method of induction motors is the auto transformer starting. Since we know that the torque is proportional to square of the voltage. By auto transformers the starting voltage and current are reduced to overcome the problem of overheating due to very high current flow. During starting the ratio of the transformer is set in a way that the starting current does not exceed the safe limit. Once the induction motor starts running and reaches a steady state value, the auto transformer is disconnected from the supply. The circuit diagram is given here with





# Reactor starter

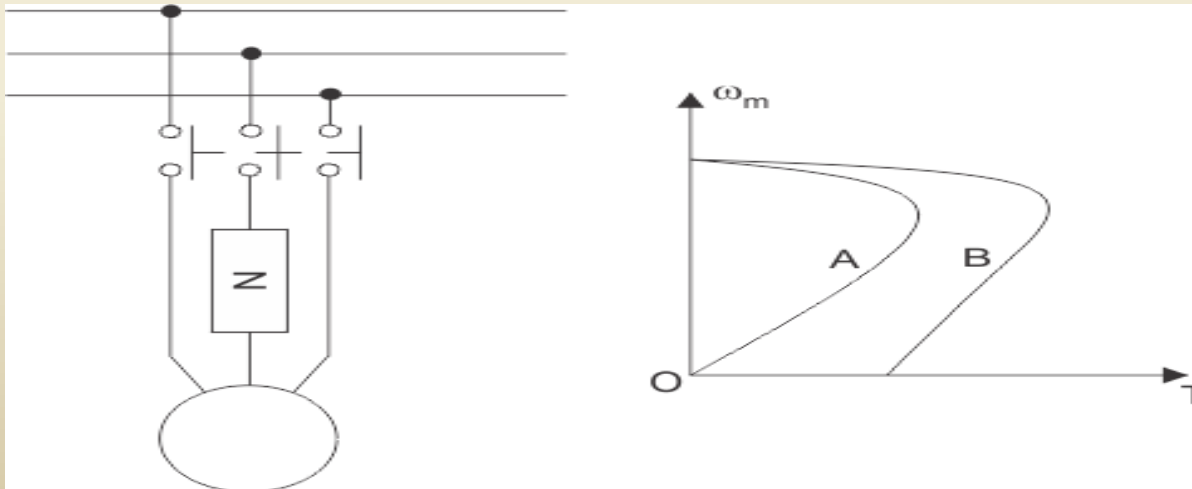
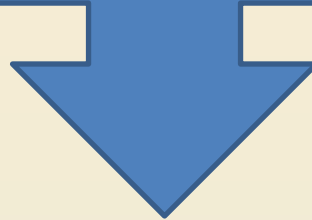
Another method of starting is softstart using saturable reactor drivers. In this method high reactance is introduced into the circuit so that the starting torque is closed to zero. Now the reactance is reduced smoothly during starting and the starting current increases and the torque also varies steplessly. In this method the motor starts without any jerk and the acceleration is smooth, that's why its called soft start also.





# Saturable reactor starter

Unbalanced starting scheme for soft start is another type of starting method where the impedance is introduced only in one of the supply phases. During starting the impedance is kept very high so that the motor operates as a single phase motor, the speed torque characteristics at that time is similar to curve A in the graph. When the speed attains a steady state value the impedance is removed completely, at that time the curve is similar to B, which is the natural characteristics of the machine. This starting method is also without any jerk and the operation is very smooth.

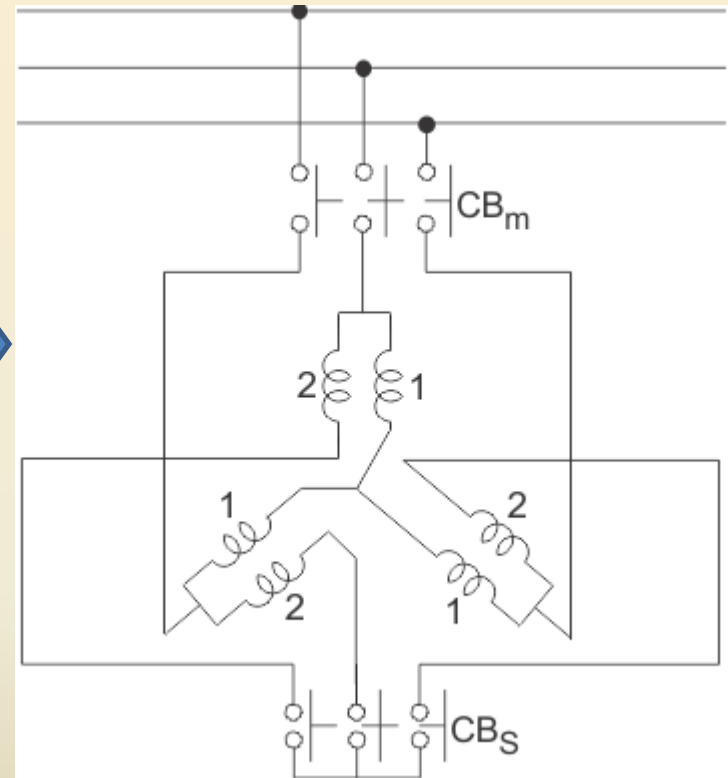






# Part winding starter/ Squirrel Cage Induction Motor

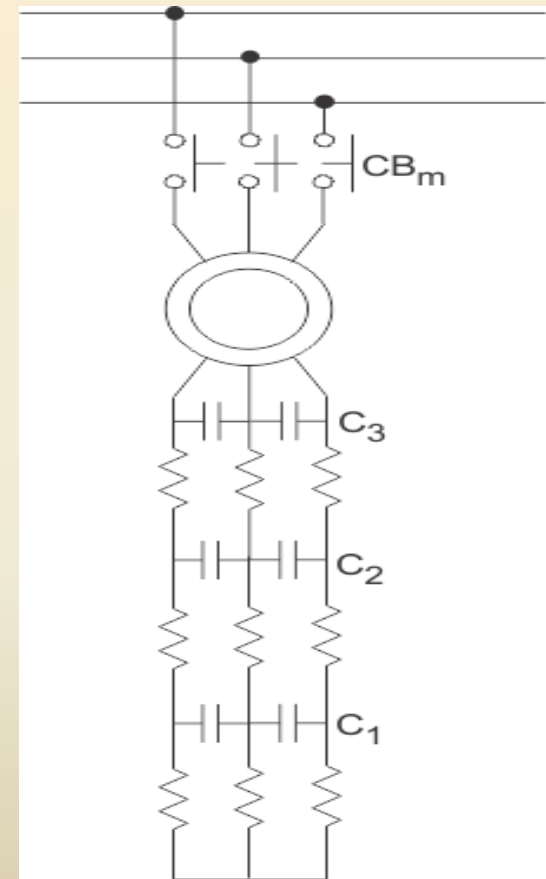
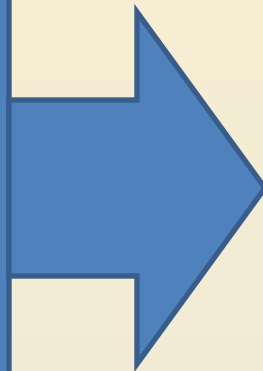
Part winding starting method is special for squirrel-cage induction motors. In this method two or more starter winding are connected in parallel. When the motor starts, any one of the winding is connected as a result the starter impedance is increased and starting current is reduced. When the steady speed is acquired by the motor both the windings are connected.





# Rotor resistance starter

Specifically for wound rotor motors, a rotor resistance starter is used. In this method, external resistors are used in the rotor circuit to limit the starting current. The maximum value of resistance is chosen to limit the current at zero speed within the safe value. As the speed increases, the sectional resistance is the temperature rise is lower than other methods of starting high acceleration, frequent starts and stops starting with heavy loads can be done with this type of starting method.





# Braking of Motors

When it comes to controlling an electric machine by electric drivers braking is a very important term because it helps to decrease the speed of the motor according to will and necessity. **Braking of induction motors** can be classified mainly in three types

1. **Regenerative braking.**
2. **plugging or reverse voltage braking**
3. **Dynamic braking**

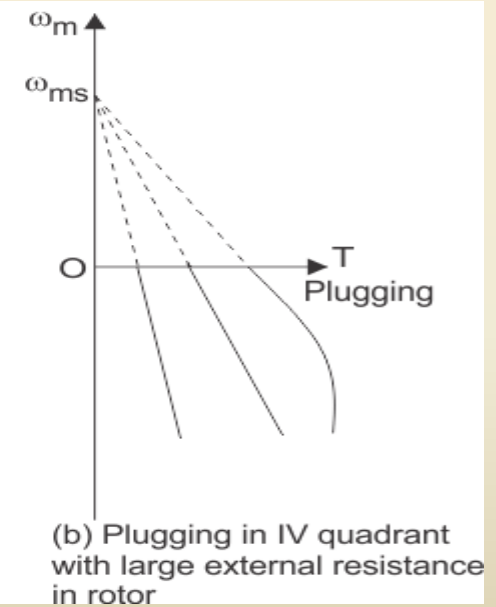
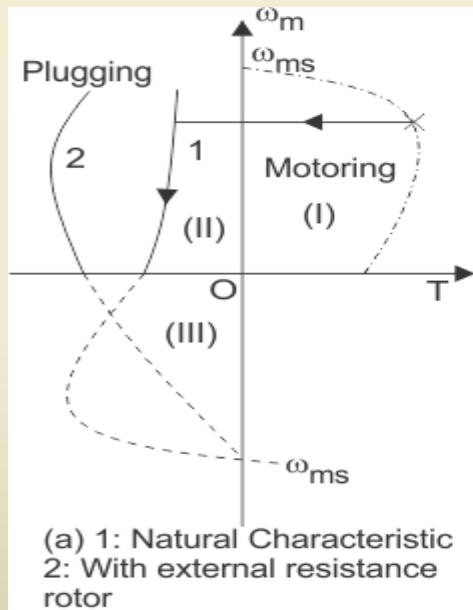
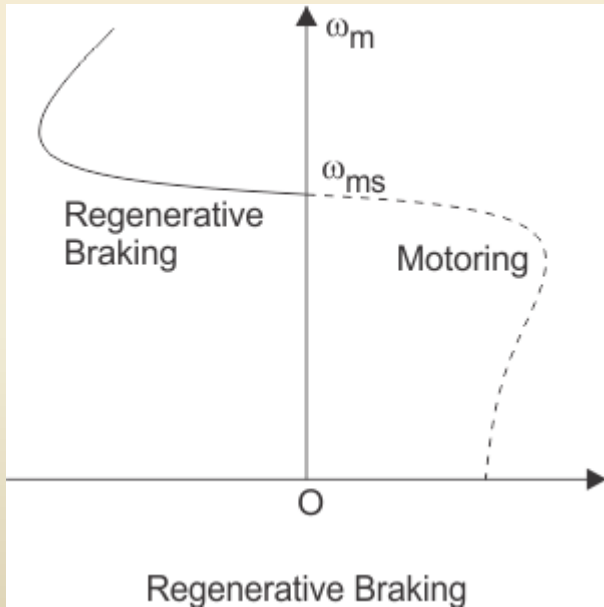
which can be further classified as

- AC dynamic braking
- Self-excited braking using capacitors
- DC dynamic braking
- Zero sequence braking



# Braking of Motors

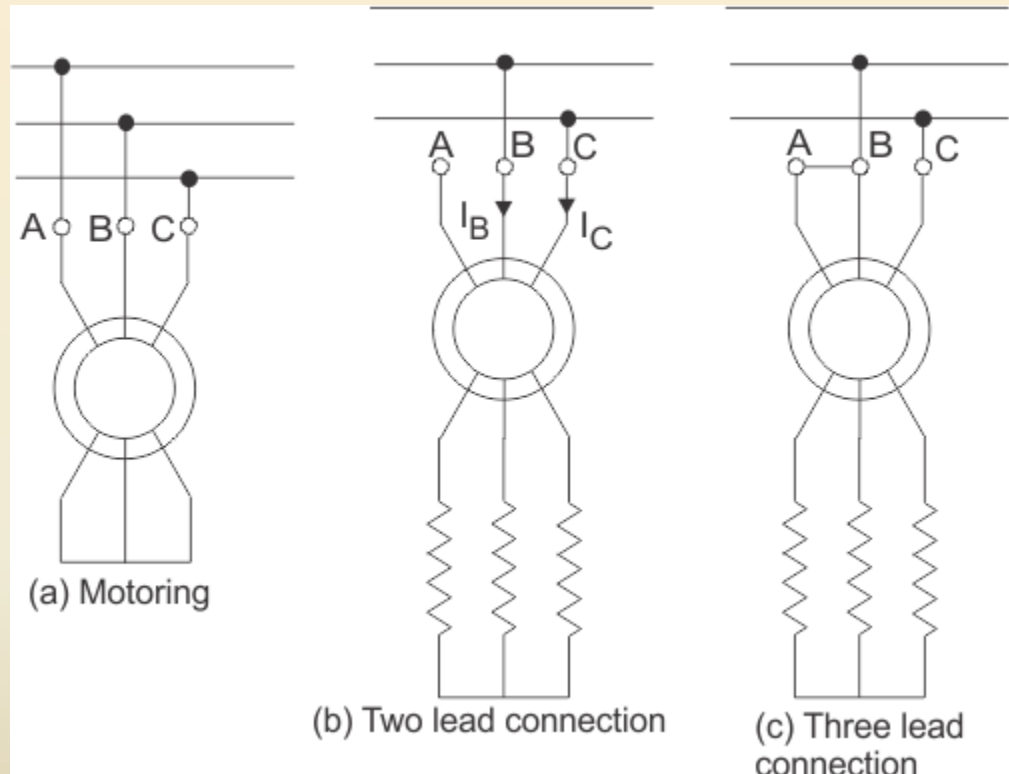
Characteristics of braking





# Braking of Single Phase System Motors

The first classification of dynamic braking of induction motors is AC dynamic braking any one of the supply phase is disconnected from the supply and then it is either kept open or connected with the other phase. The first type is known as two lead connection and the second one is known as three lead connection





# Speed Control of Induction Motors

Pole changing

Stator voltage control

ReacSupply  
frequency  
controltor  
starter

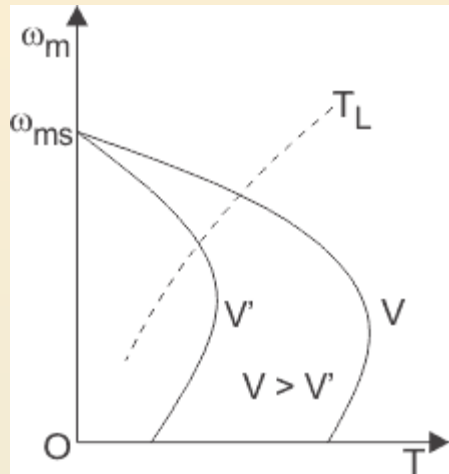
Eddy current  
coupling

Rotor  
resistance  
control

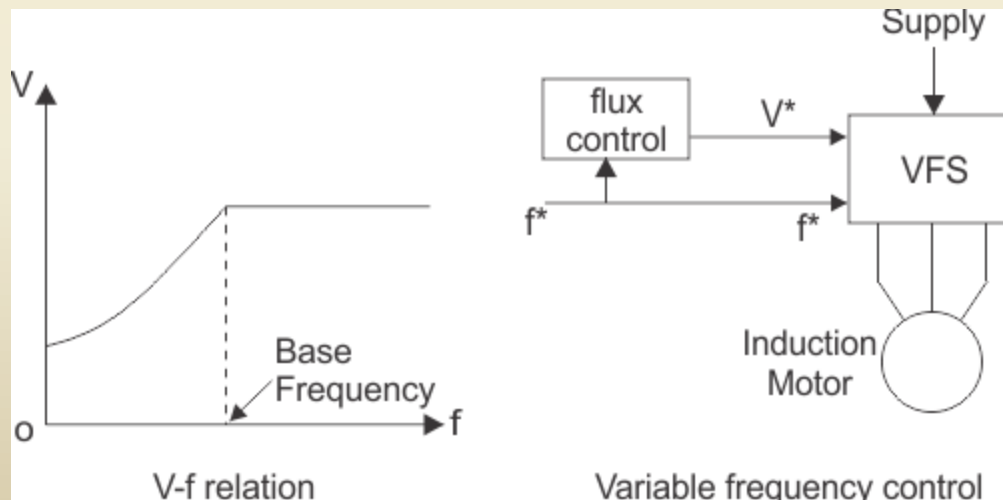
Slip power  
recovery



# RELATION AND FREQUENCY CONTROL



The speed of an induction motor is proportional to the product of the supply frequency and air gap flux. But as there is a chance of magnetic saturation while decreasing the supply frequency, that's why not only the frequency but the  $v/f$  the ratio of supply voltage and frequency is controlled and this ratio is tried to be kept constant. And if the speed is needed to be changed the ratio of  $v/f$  is changed accordingly.

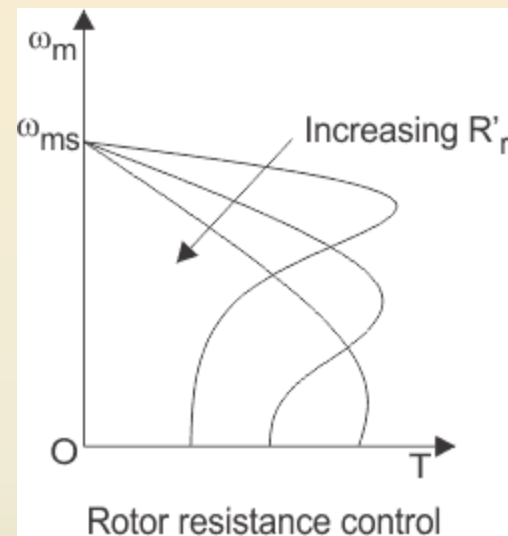




# ROTOR RESISTANCE CONTROL

The eddy current speed control method is done by placing an eddy current clutch between an induction motor is running at a fixed speed and the variable speed load. Now what is this eddy current clutch? It is nothing but an induction motor drives in which both stator and the rotor are allowed to rotate. The rotor is coupled with the main induction motor. When eddy currents are produced in the rotor drum, their interaction with the stator field and a torque is produced which rotates the main motor. By controlling the DC current through the stator winding the speed of the motor can be controlled.

Depending on the rotor resistance, the speed of the rotor falls or increases. The variation of speed torque characteristics with respect to change in rotor resistance is shown in the figures below. This speed controlling method is better than many other methods because of low cost.







*THANK  
YOU*