Assignment.

1

Subject.

Electrical Machines 2 (Ac Machines)

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Electrical Machines 2

Q#1

* Write Introduction, Advantages, disadvantages and Construction of three phase Induction Motor.

Ans:- An Induction motor is an Ac electric motor in which the electric motor in which the electric current in the rotor needed to produce torque is obtained by electromagnetic induction from the magnetic field of stator windings.

Induction Motor are also known as asynchronous Motor because its rotor rotates at a speed less than the Synchronous speed. They run at essentially constant speed from no-load to full-load. However, the speed is frequency dependent and Consequently these motors are not easily adopted to speed control.

=> The three phase induction motor is the most widely used electrical motor. Almost 80% of the mechanical Power used by industries is Provided by three phase induction Motors.

Advantages :-

1- The working of an induction motor is very simple. It can operate in any environmental condition. The construction of an induction motor robust and sturdy.

2- Induction motors are cheaper in cost due to the absence of brushes, Commutators, and slip rings.

3- It is highly efficient motor. The efficiency of Induction Motor is varying from 85 to 95%.

4- The brushes are not used in an induction motor, so, there are no sparks in the motor and it can be used in polluted and hazards environment.

5. The maintenance of Induction Motor is very less compared to the DC motor and synchronous motor.

6. 3 phase induction motor is the self-starting motor so any special starting arrangement is not required.

7. The speed variation from no-load to rated load is very less.

DisAdvantages :-

1- The Power factor of the motor is very low during the light load condition.

2. The motor can not be used in such applications where high starting torque is necessary like traction and lifting weight.

3. It is essentially a constant speed motor and its speed cannot be changed easily.

Construction :-

like any other electrical motor induction motor also have two main parts namely (i) stator and (ii) rotor. The rotor is seperated from the stator by a small air-gap which ranges from 0.4 mm to 4mm, depending upon the Power of motor.

The main body of the induction motor comprises of :

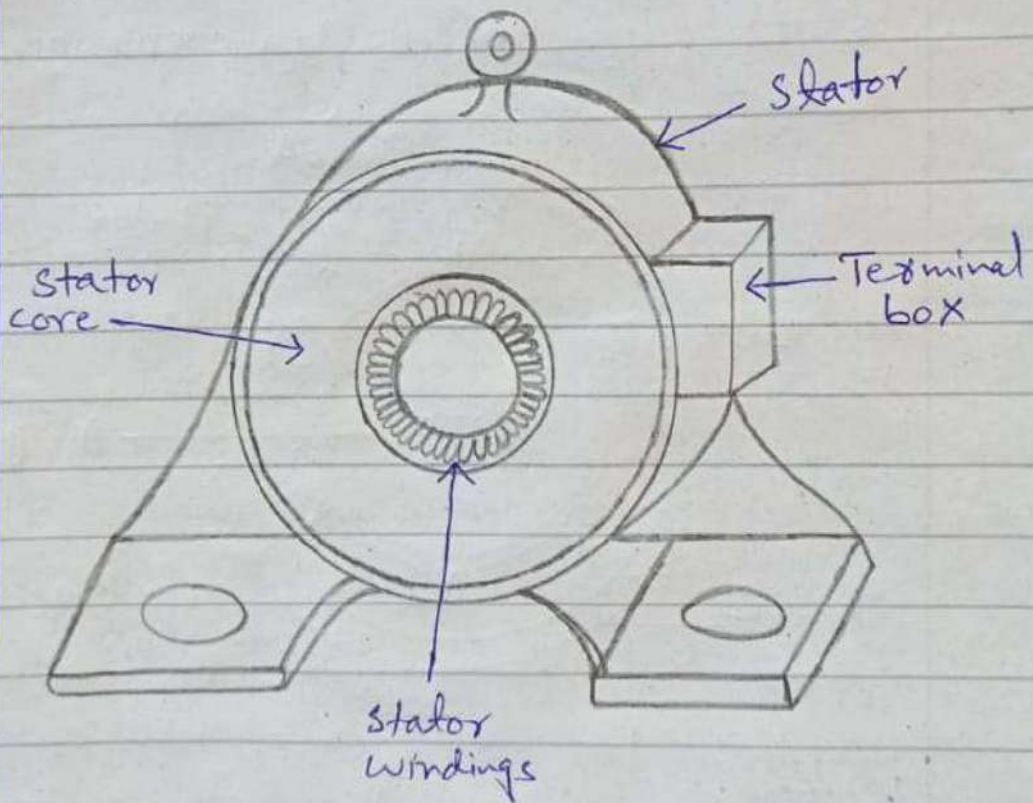
1- Shaft for transmitting the torque to the load. This shaft in made up of steel.
2. Bearings for supporting the rotating shaft.
3. Terminal box for receiving external electrical connection.
4. fan in needed for cooling.

* Stator :

Stator is a stationary Part of induction motor. A stator winding is placed in the stator of induction motor and three phase supply is given to it.

Stator is made up of number of stamping in which different slotes are cut to receive 3 phase winding circuit which are Connected to 3phase Ac supply.

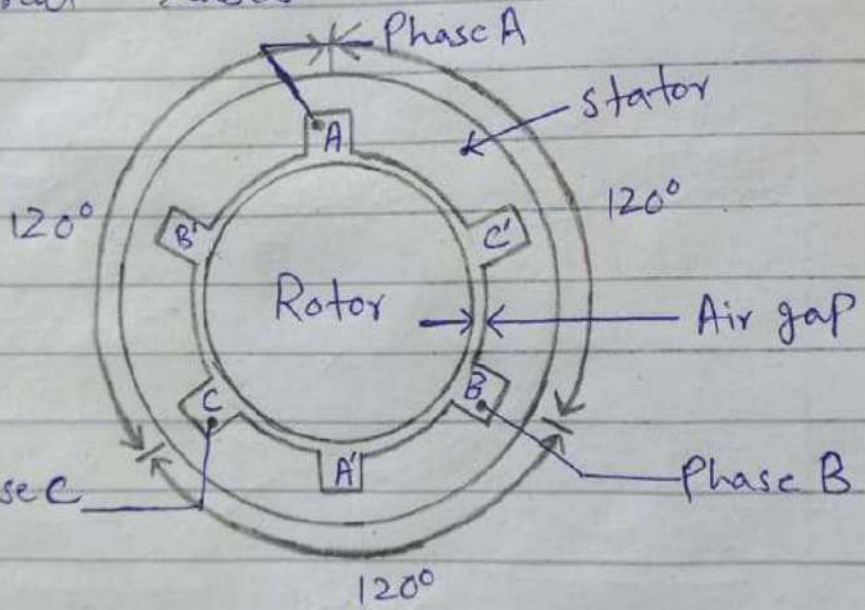
Stator is wounded with three-phase windings which are overlapped with one another at 120 degree phase shift into slotted laminations.



The windings are wounds for a definite number of poles depending upon the speed requirment, as speed is inversely Proportional to the number of poles.

$$N_s = 120f/p$$

where N_s = Synchronous speed
f = frequency
P = no. of Poles
Greater the no. of Poles, lesser is the speed of the motor and vice versa.
It consists of a steel frame which encloses a hollow, cylindrical core made up of thin laminations of silicons steel to reduce hysteresis and eddy current losses.



Rotor:

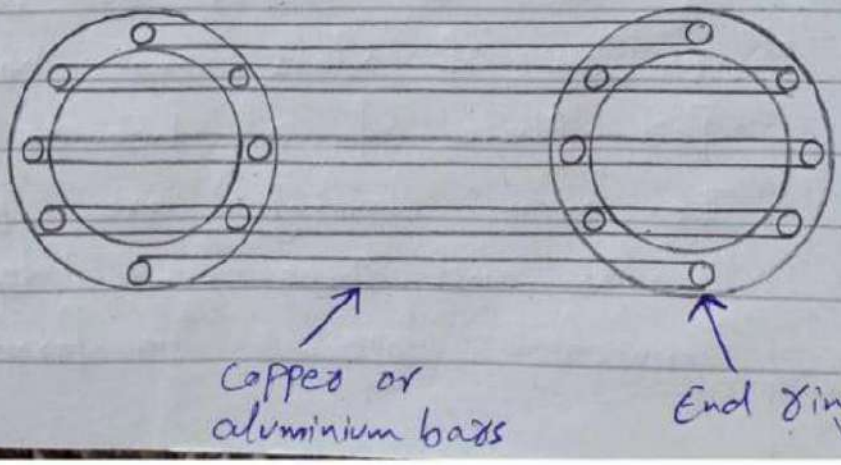
The rotor is a rotating part of induction motor. The rotor is connected to the mechanical load through the shaft. Rotor consists of cylindrical laminated core with

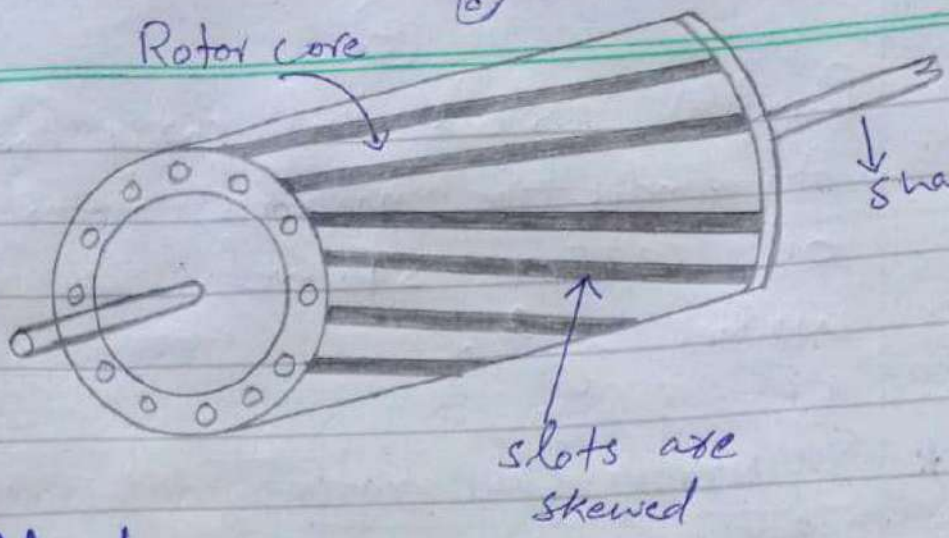
Parallel slots that carry conductor bars. An induction motor's rotor can be either squirrel-cage type or wound type.

* Squirrel Cage rotor:

Squirrel cage rotor is cylindrical in shape and have slots on its periphery. The slots are not made parallel to each other but are bit skewed as the skewing prevents magnetic locking of stator and rotor teeth and makes the working of motor more smooth and quieter.

The squirrel cage rotor consist of aluminium, brass or copper bars Conductor. The rotor conductors are Parmanently shorted by copper or aluminum rings Called the end rings.





Advantages:-

Its Construction is very simple and rugged.

⇒ As there are no brushes and slip rings these motors requires less maintenance.

Application:

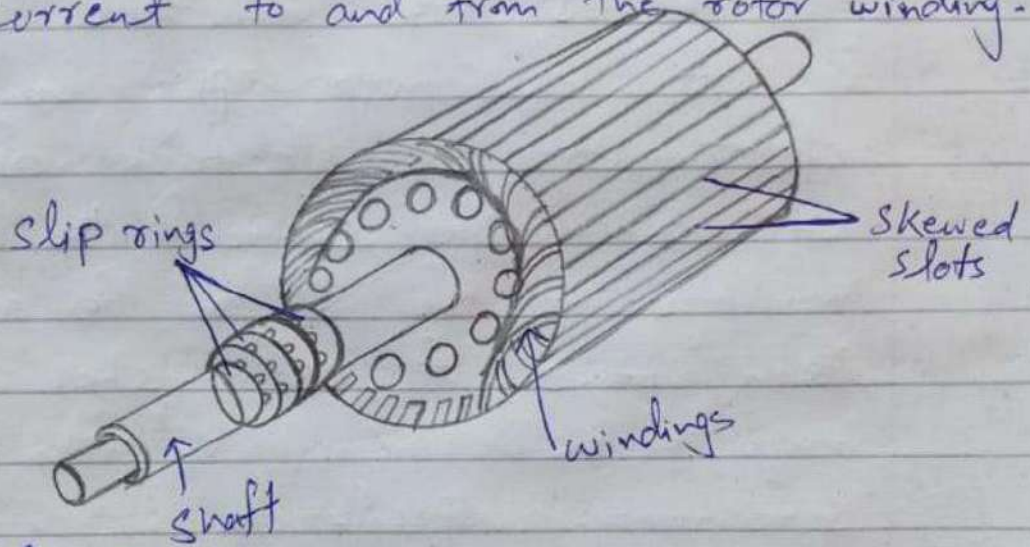
Squirrel cage induction motor is used in lathes, drilling machines, fan, blower Printing machines e.t.c.

* **Wound rotor:**

In this type of three phase induction motor the rotor is wound for the same no. of poles as that of stator but it has less number of slots and has less turns per phase of a heavier conductor. The rotor windings are placed in slots and three end terminals are connected together to form star connectio

slip rings are connected on same shaft as that of rotor. The three ends of Phase windings are Permanently Connected to these slip rings.

For developing a high-starting torque these windings are connected to rheostat with the help of carbon brushes. The brushes are used to carry current to and from the rotor winding.



Advantages:

1- It has high starting torque and low starting Current.
2. Possibility of adding additional resistance to control speed.

Application:

Slip ring induction motor are used where high starting torque is required i.e in hoist, cranes, elevators.

Q NO: 2

Q. Write operation Principal (working) of three Phase induction Motor.

Ans. The working Principal of a three Phase induction Motor is "Faraday's law of electromagnetic induction".

The stator of the motor consist of overlapping windings offset by an electrical angle of 120° - when we connect the primary windings or the stator to a 3ϕ Ac source, it establishes rotating magnetic field which rotates at the synchronous speed.

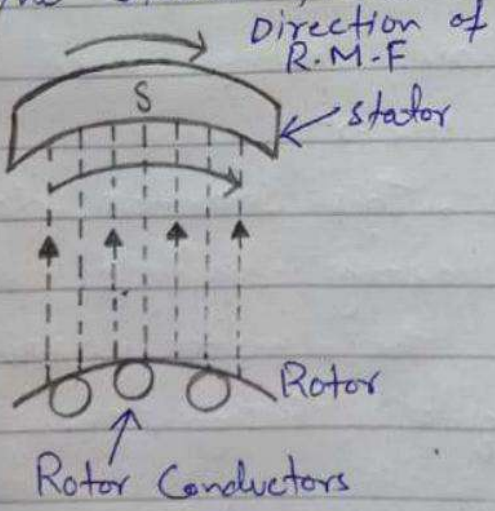
This changing magnetic field cuts the rotor conductors and induces a current in them according to the Principal of electromagnetic induction - As these rotor conductors are shorted, the current starts to flow through these conductors.

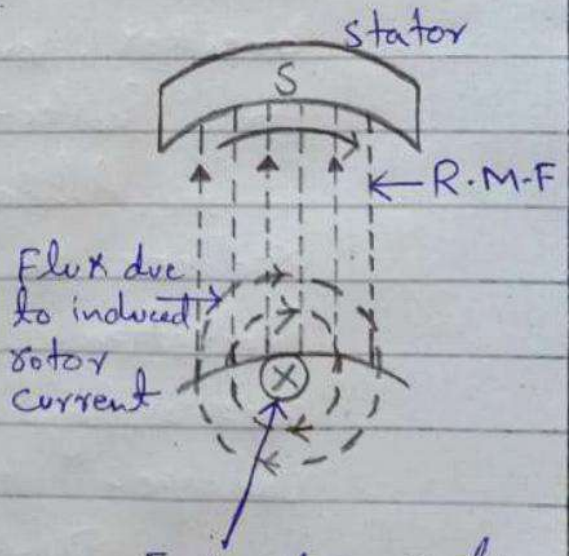
The rotor conductors' rotation can be explained by lenz's law

which tells that the induced currents in the rotor oppose the cause for its production, here this opposition is rotating magnetic field. This result the rotor starts rotating in the same direction of the stator rotating magnetic field.

If the rotor speed is more than stator speed, then no current will induce in the rotor because the reason for rotor rotation is the relative speed of the rotor and stator magnetic fields.

Hence, for producing rotation, the rotor speed must always be less than the stator field speed.





Q NO: 3

* Discuss different types of starter for three phase induction Motor.

i). Direct on-line starter (DOL)

A DOL starter or across the line starter is a method of starting of a 3 phase induction motor. In DOL starter an induction motor is connected directly across its 3-phase supply, and the DOL applies the full line voltage to the motor terminal.

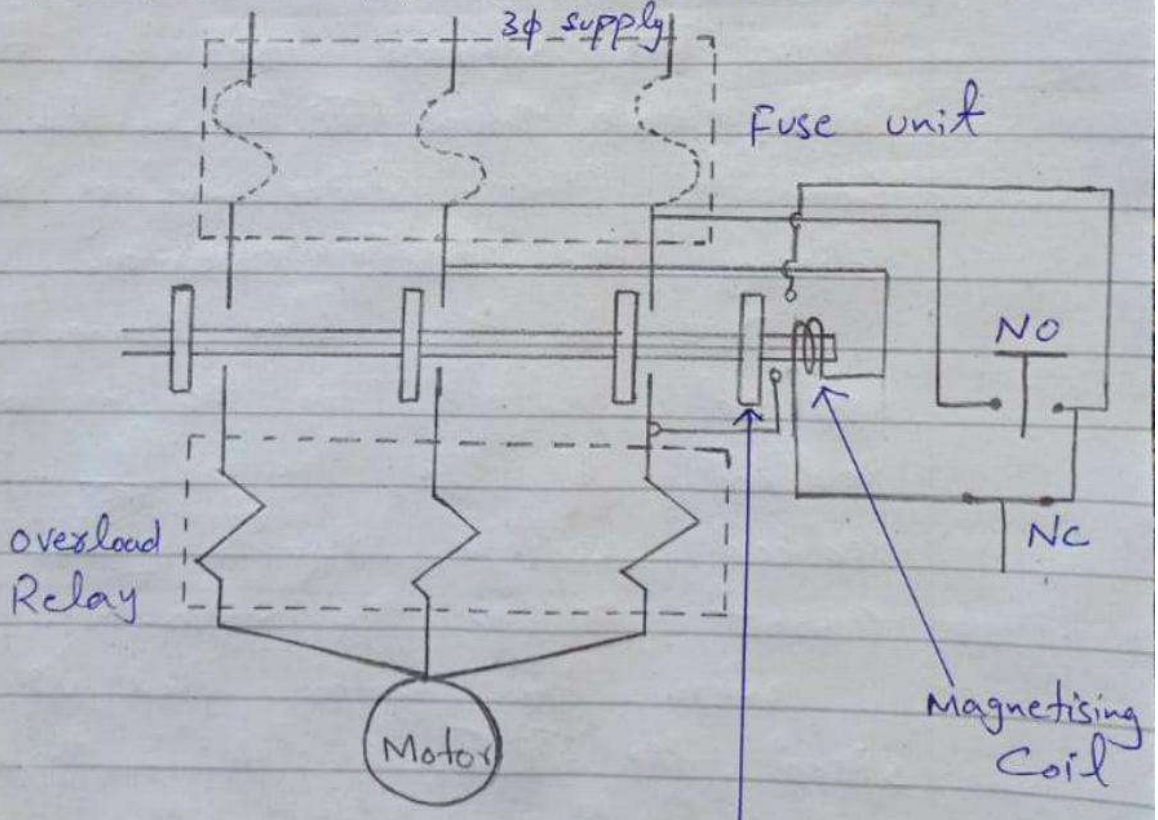
A DOL motor starter contains Protection devices such as circuit breaker, overload relay and contactor for Protecting motor

Although, this starter doesn't reduce the starting voltage it Provide Protection to the motor against overloading single Phasing and low voltage.

During start conditions, normally open contact is Pushed for fraction

of a second and this makes the magnetising coil become energised. This magnetic flux produced by the coil attracts the contactor so that the motor is now connected to the supply.

when a Normally closed switch is pressed the coil becomes de-energised and the contactor get separated by spring arrangment there by the supply to the motor is removed.



(DOL starter)

2. Star-Delta starter:

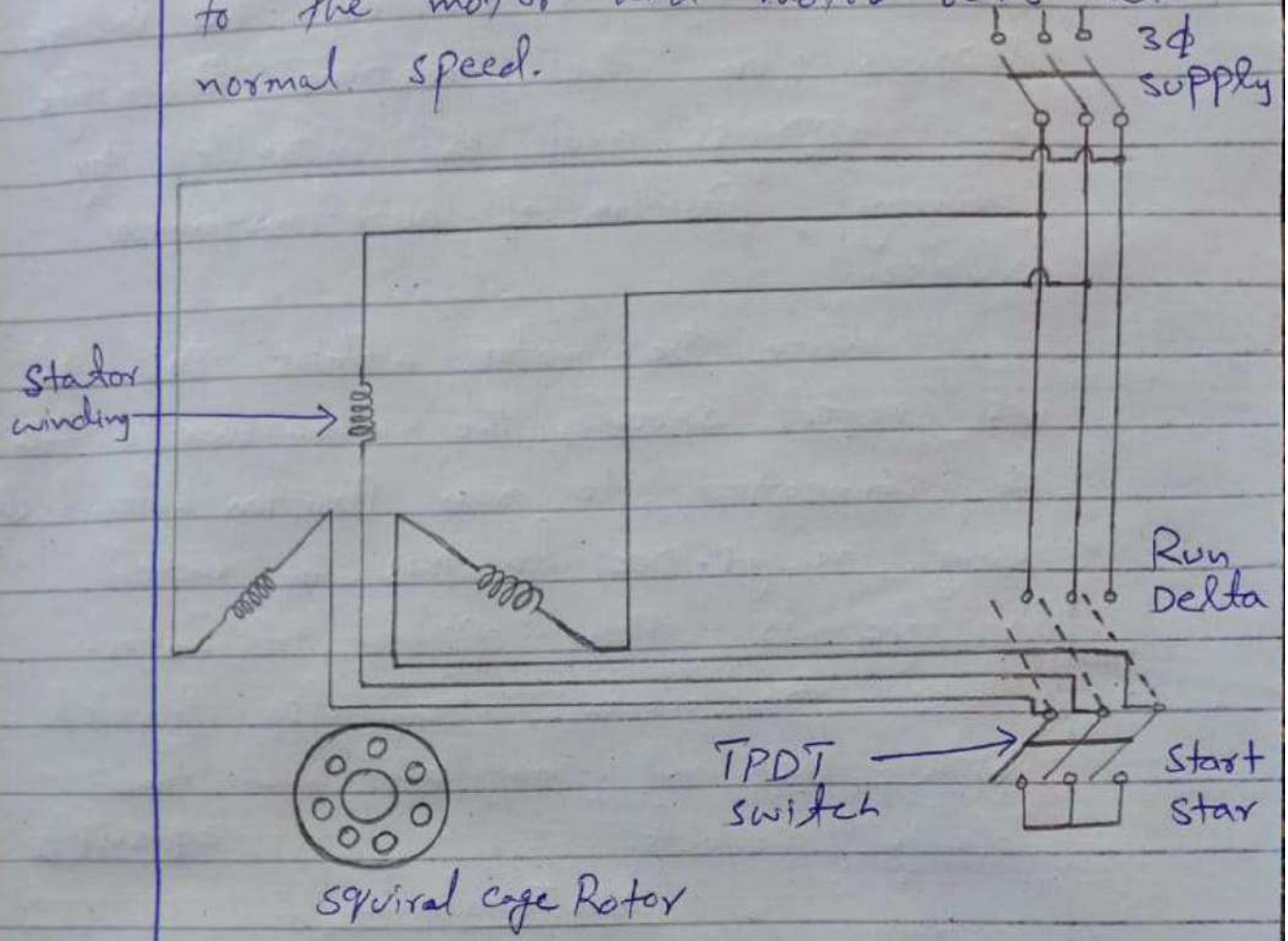
A star delta starter is the most commonly used method for the starting of a 3-phase induction motor.
In star delta starting an induction motor is connected in through a star connection throughout the starting period. Then once the motor reaches the required speed, the motor is connected in through a delta connection.

This starter uses a triple pole double throw (TPDT) switch and it connects the stator winding in star during the starting condition.

Due to this star connection, the applied voltage to the motor is reduced by the factor $\frac{1}{\sqrt{3}}$. This reduced voltage results the less current through the motor.

When the motor pick up the speed, the TPST switch is thrown automatically on the other side by using relay such that the winding is now connected in delta across the supply.

So the normal voltage is applied to the motor and motor runs at normal speed.



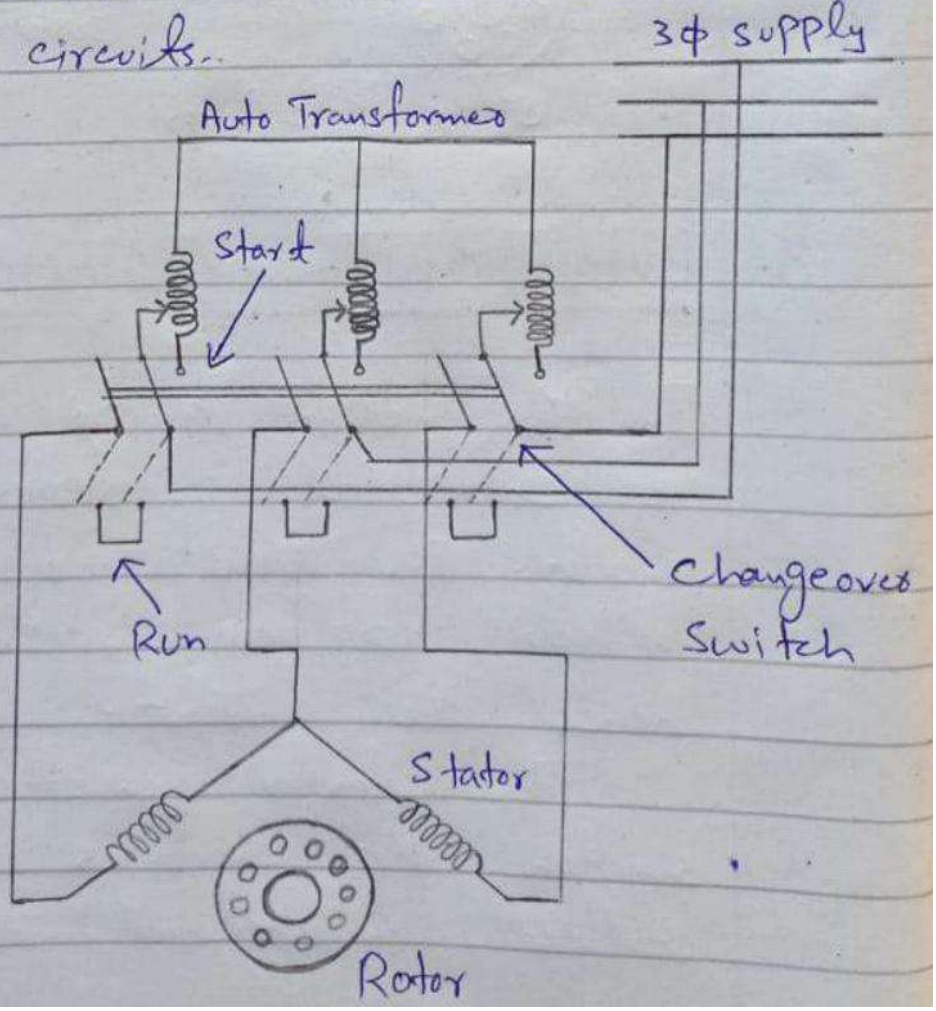
3. Auto transformer starter:

In this method, a 3ϕ auto transformer is connected in series with the motor. This transformer reduces the voltage applied to the motor and hence the current.

The starter consist of changover switch that switches the motor between reduced voltage and full voltage condition.

when this switch is in the start position, voltage is reduced. This voltage depends on the fractional percentage of tappings and is controlled by changing position of autotransformer slides.

When the motor attains 80% of its rated speed, the changeover switch is connected to run position automatically using relays. Due to this, a rated voltage is then applied to motor. These transformers are also provided with overload, no-load and time delay circuits.



4. Rotor Impedance starter:

The easiest method of starting wound rotor induction motor is to connect some extra resistance in the rotor circuit.

Connection of extra resistance in the rotor circuit decrease and at the same time increase the starting torque. As the motor starts rotating, the extra resistance is gradually cut.

When the motor attains rated speed the resistance is fully cut out and the slip ring terminals are short circuited.