



جامعة الموصل / كلية الهندسة

قسم الهندسة الكهربائية

Subject Title: Single Phase Induction Motors
(المحركات الحثية احادية الطور)

Subject Code: SPIM404

Class 4: Power and Machines

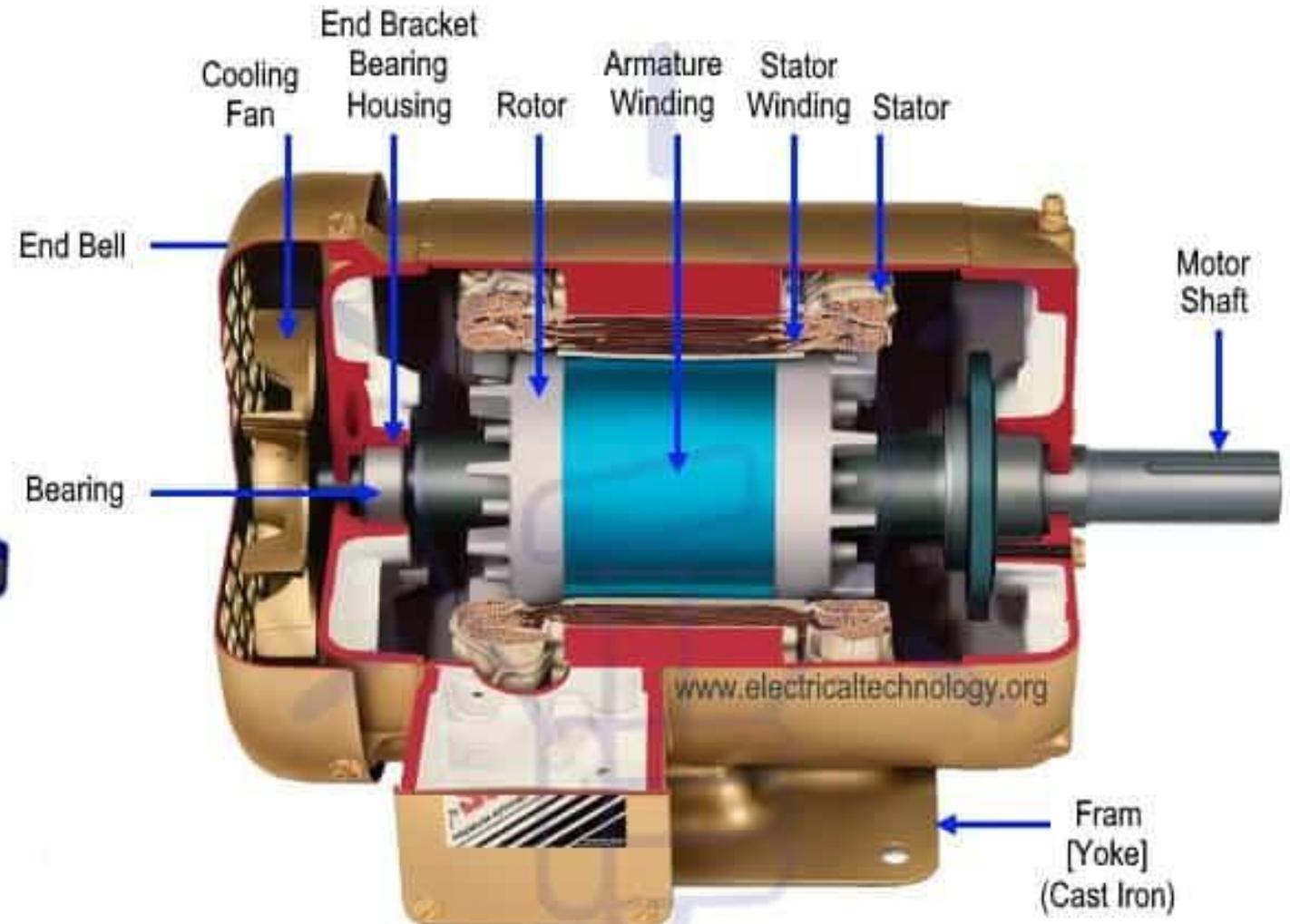
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Course Description (15 weeks) or Outlines

- Introduction, Single phase induction motors: Principal of operations,
- Types of SPIM,
- Motors with main winding only,
- Cross field theory, Rotating field theory (Double-field revolving theory),
- Transformer voltage, Rotational voltage,
- Torque speed characteristic, Fields in SPIM,
- Equivalent circuit, Power diagram,
- Two phase induction motor,
- Symmetrical two-phase motor supplied from two-phase balance system,
- Symmetrical two-phase motor supplied from two phase unbalance system,
- Unsymmetrical two-phase motor supplied from two phase unbalance system,
- Special cases, Single phase motors with main and auxiliary windings,
- Improvement of torque production in single-phase induction motor.

Construction of Single-Phase Induction Motor



Rotor



Stator



Construction of Single-Phase Induction Motor

A single phase induction motor is similar to the three phase squirrel cage induction motor except there is single phase two windings (instead of one three phase winding in 3-phase motors) mounted on the stator and the cage winding rotor is placed inside the stator which freely rotates with the help of mounted bearings on the motor shaft. The construction of a single-phase induction motor is similar to the construction of a three-phase induction motor.

Types of Single-phase Induction Motors

The single-phase induction motors are classified as;

- Split Phase Induction Motor
- Shaded Pole Induction Motor
- Capacitor Start Induction Motor
- Capacitor Start Capacitor Run Induction Motor

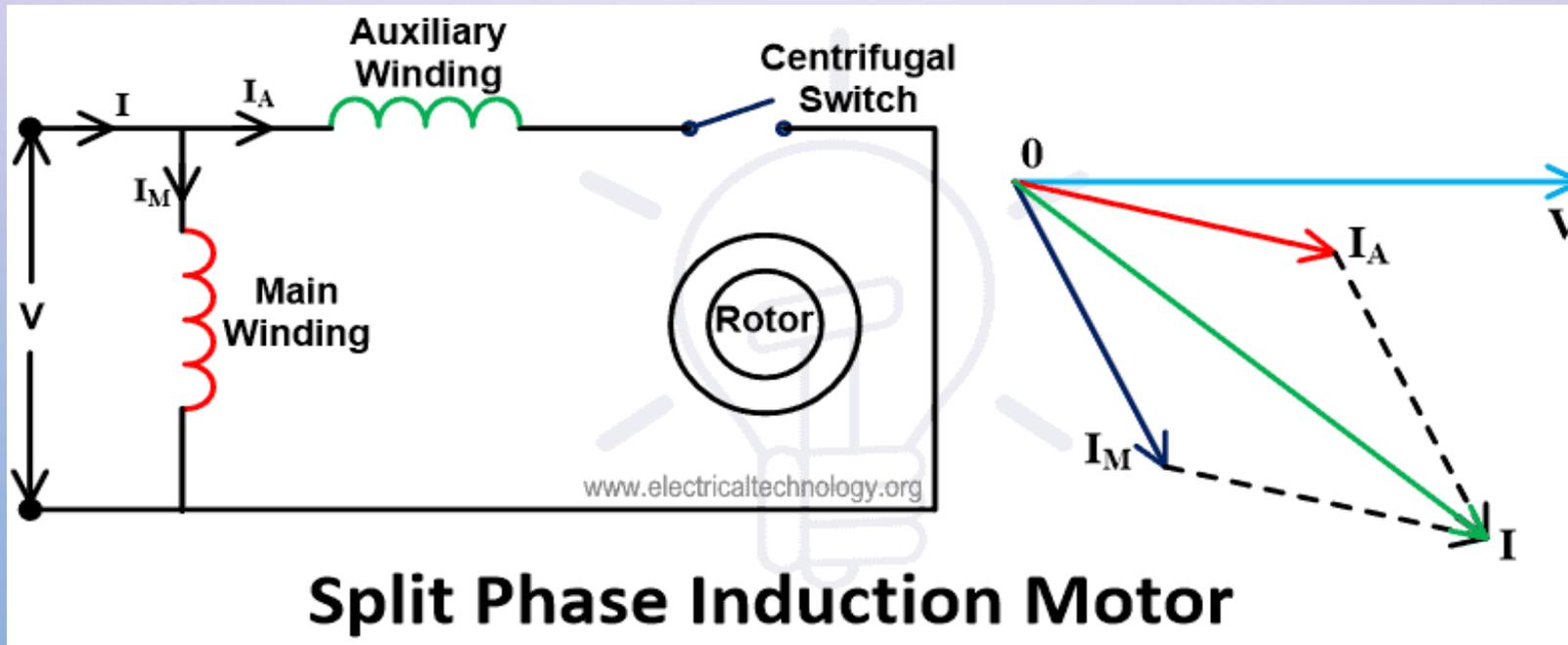
Split Phase Induction Motor

In this type of motor, an extra winding is wound on the same core of the stator. So, there are two windings in the stator.

One winding is known as the main winding or running winding and second winding is known as starting winding or auxiliary winding. A centrifugal switch is connected in series with the auxiliary winding.

The auxiliary winding is highly resistive winding and the main winding is highly inductive winding. The auxiliary winding has few turns with a small diameter. The aim of auxiliary winding is to create a phase difference between both fluxes produced by the main winding and rotor winding.

The connection diagram is as shown in the below Figure. The current flowing through the main winding is I_M and current flowing through the auxiliary winding is I_A . Both windings are parallel and supplied by voltage V . The auxiliary winding is highly resistive in nature. So, the current I_A is almost in phase with supply voltage V .



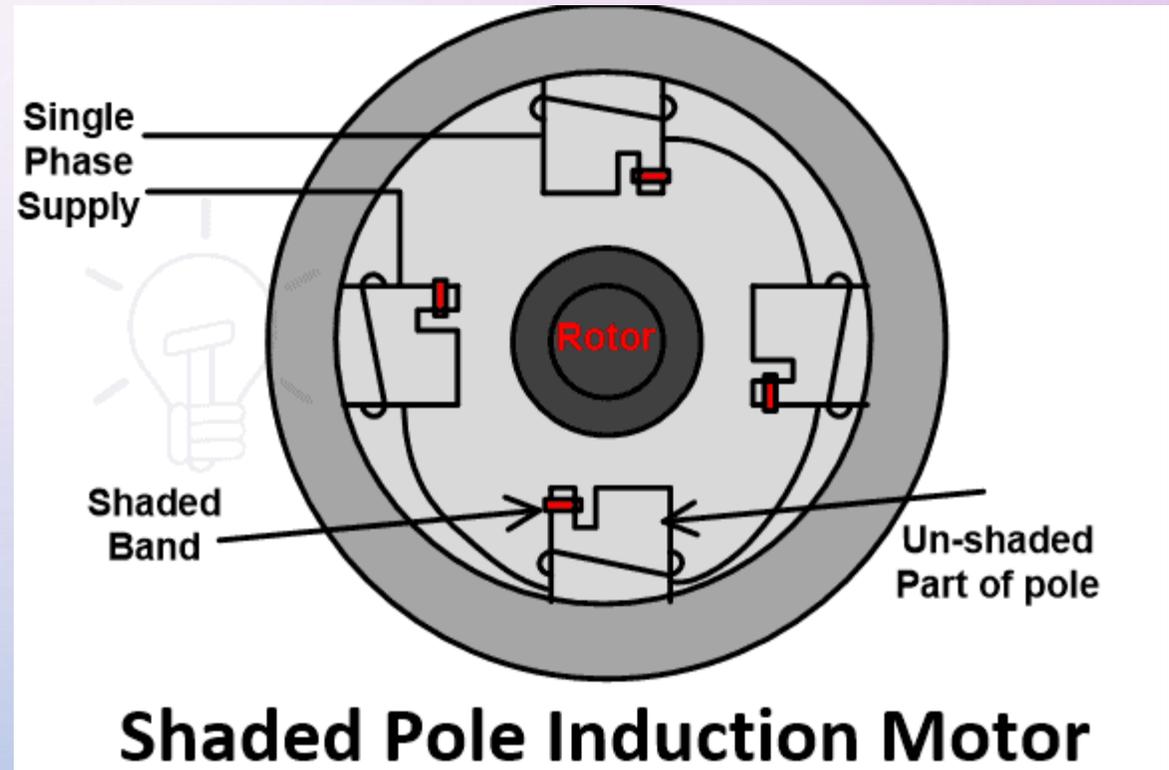
Shaded Pole Induction Motor

As compared to other types of single-phase induction motor, this motor has a different construction and working principle. This type of motor does not require auxiliary winding.

This motor has stator salient pole or projecting pole and the rotor is the same as squirrel cage induction motor. The stator poles are constructed specially to create a rotating magnetic field.

A pole of this motor is divided into two parts; shaded part and un-shaded part. It can be created by cutting pole into unequal distances.

A copper ring is placed in the small part of the pole. This ring is a highly inductive ring and it is known as a shaded ring or shaded band. The part at which shaded ring is placed is known as shaded part of the pole and the remaining part is an unshaded part. The construction of this motor is as shown in the given Figure.



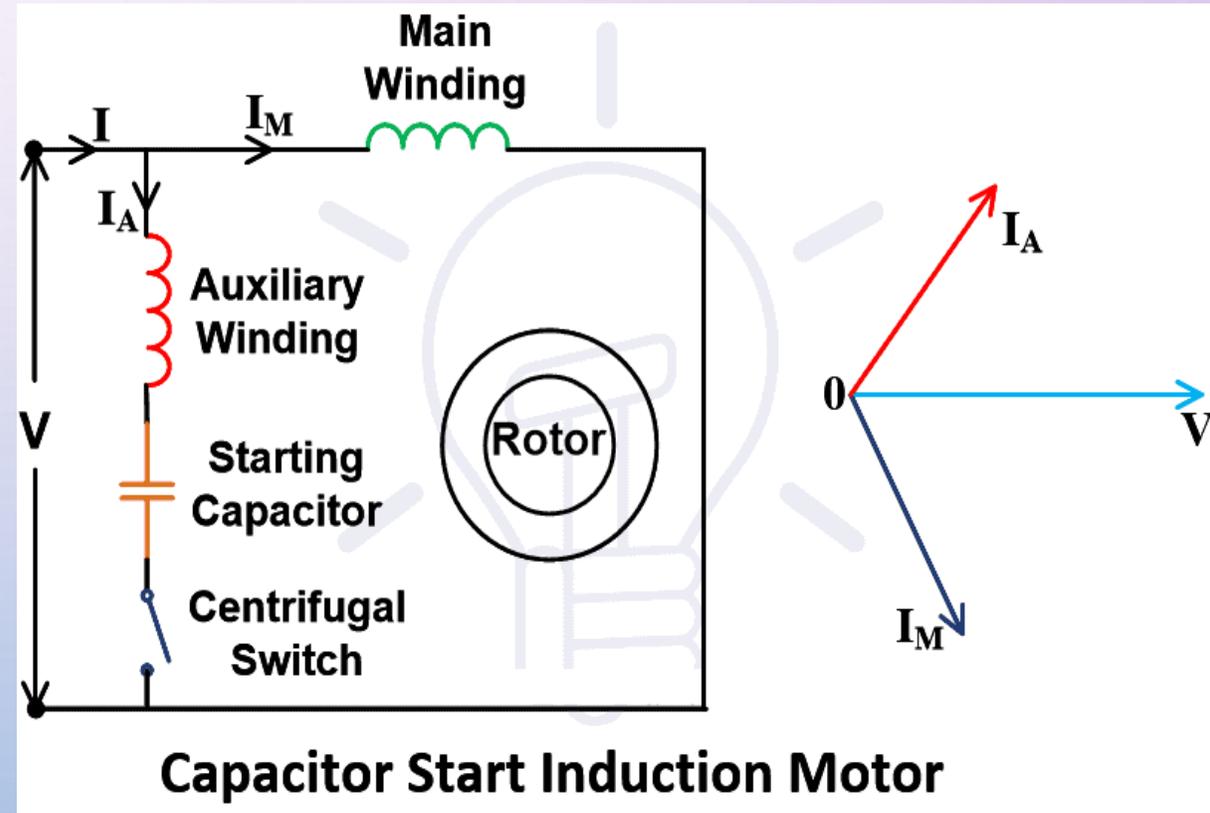
Capacitor Start Induction Motor

This type of motor is an advanced version of the Split phase induction motor. The disadvantage of split-phase induction is low torque production. Because in this motor, the phase difference created is very less.

This disadvantage compensates in this motor with the help of a capacitor connected in series with auxiliary winding. The circuit diagram of this motor is as shown in the below figure.

The capacitor used in this motor is a dry-type capacitor. This is designed to use with alternating current. But this capacitor is not used for continuous operation.

In this method also, a centrifugal switch is used which disconnects the capacitor and auxiliary winding when the motor runs 75-80% of synchronous speed. The current through auxiliary will lead the supply voltage by some angle. Due to high starting torque, this motor is used in the applications where high starting torque is required like, a Lath machine, compressor, drilling machines, etc.



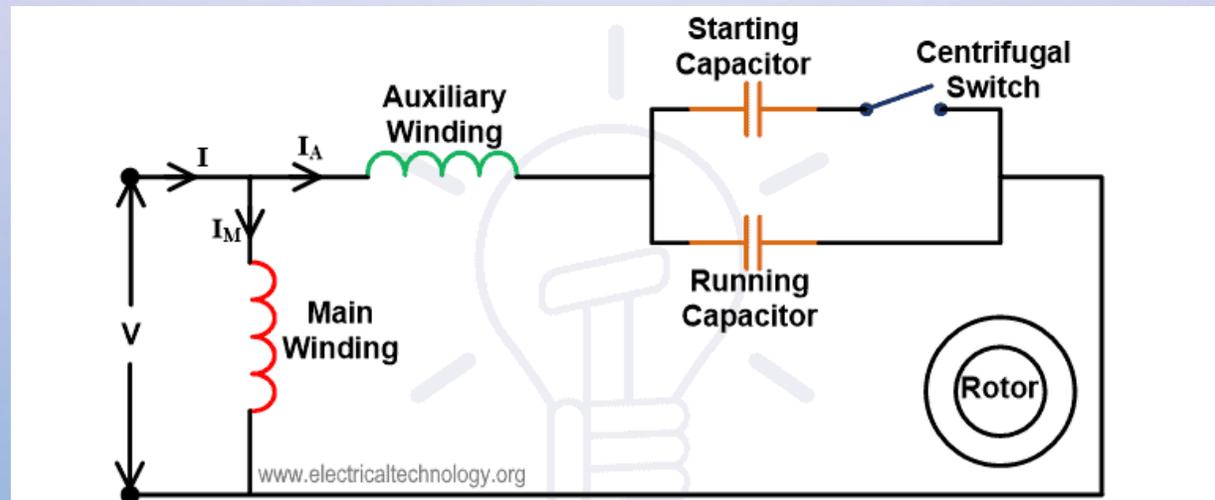
Capacitor Start Capacitor Run Induction Motor

In this type of motor, two capacitors are connected in parallel with series in auxiliary winding. Out of these two capacitors, one capacitor is used only for starting (starting capacitor) and another capacitor is connected permanently with the motor (running capacitor).

The circuit diagram of this figure is as shown in the below figure. The starting capacitor has high capacitance value and a running capacitor has low capacitance value. The starting capacitor is connected in series with a centrifugal switch that will open when the speed of the motor is 70% of synchronous speed.

During running conditions, both running winding and auxiliary winding connected with motor. The starting torque and efficiency of this motor are very high.

Therefore, this can be used in the application where high starting torque is required like a refrigerator, air conditioner, ceiling fan, compressor, etc.



Capacitor Start Capacitor Run Induction Motor

TEXTBOOK OR REFERENCES

No.	Reference
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3	Electric Machinery and their Application, J.Hindmarsh 3 rd , 1979
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7	Electric Motors and Drives, Austin Hughes, 3 rd , 2006
8	Electromechanical Motion Devices, Second Edition, Paul Krause, Oleg Wasynczuk, Steven Pekarek, Wiley-IEEE Press, Year: 2012