

SNS COLLEGE OF ENGINEERING

Coimbatore

An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC
with 'A' Grade

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

DEPARTMENT OF ELECTRONICS & ELECTRONICS ENGINEERING

ELECTRICAL ENGINEERING & INSTRUMENTATION

II YEAR/ III SEMESTER

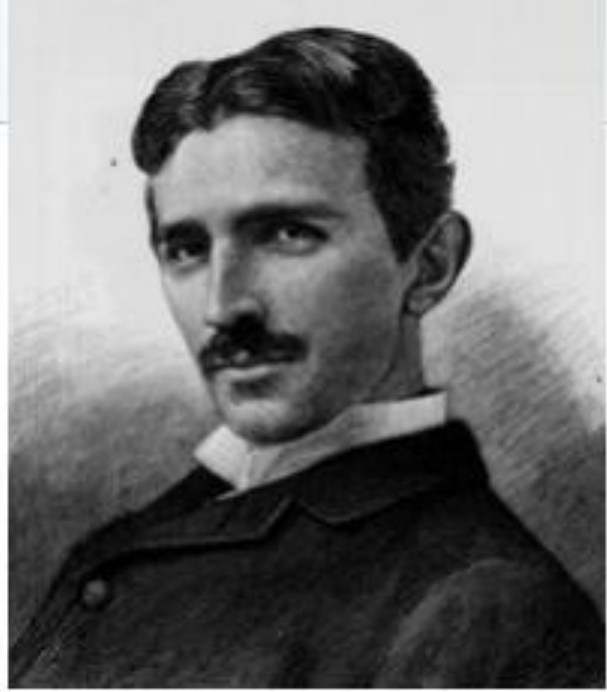
UNIT 2 – TRANSFORMERS

TOPIC 3 – ALTERNATOR/SYNCHRONOUS GENERATOR



ALTERNATOR

An **alternator** is such a machine which converts mechanical energy from a prime mover to AC electric power at specific voltage and frequency. It is also known as synchronous generator.



Nikola Tesla

1891

COURTESY:

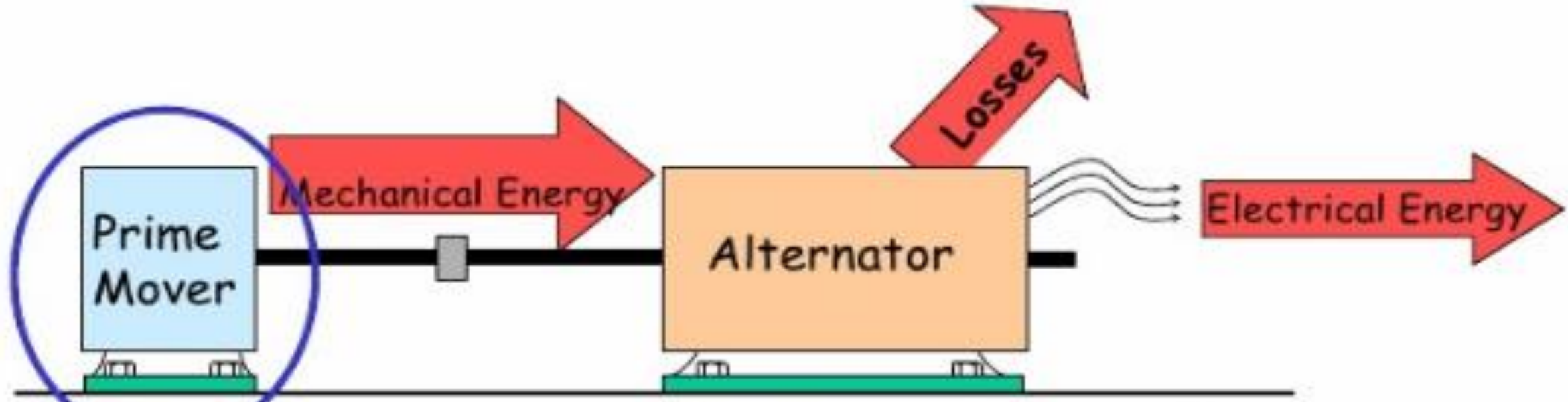
<http://people.ece.umn.edu/users/riaz/anim/maccontents.html>

<http://electricalinstallationandmaintenance.blogspot.com/2017/01/three-phase-and-single-phase-induction.html>

The **working principle of an alternator** is very simple. It is just like the basic principle of DC generator. It also depends upon Faraday's law of electromagnetic induction which says the current is induced in the conductor inside a magnetic field when there is a relative motion between that conductor and the magnetic field.

ALTERNATOR

Alternator



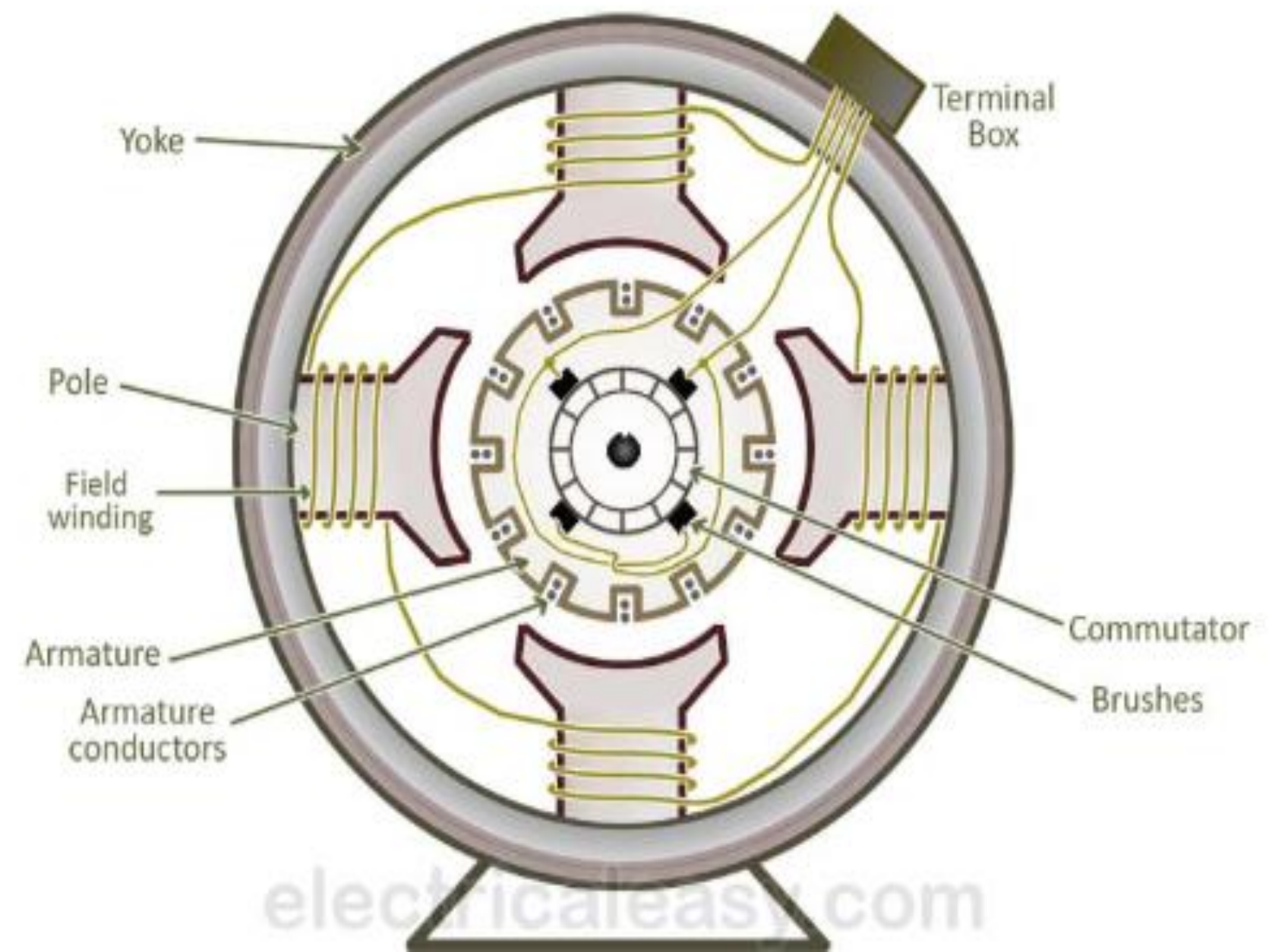
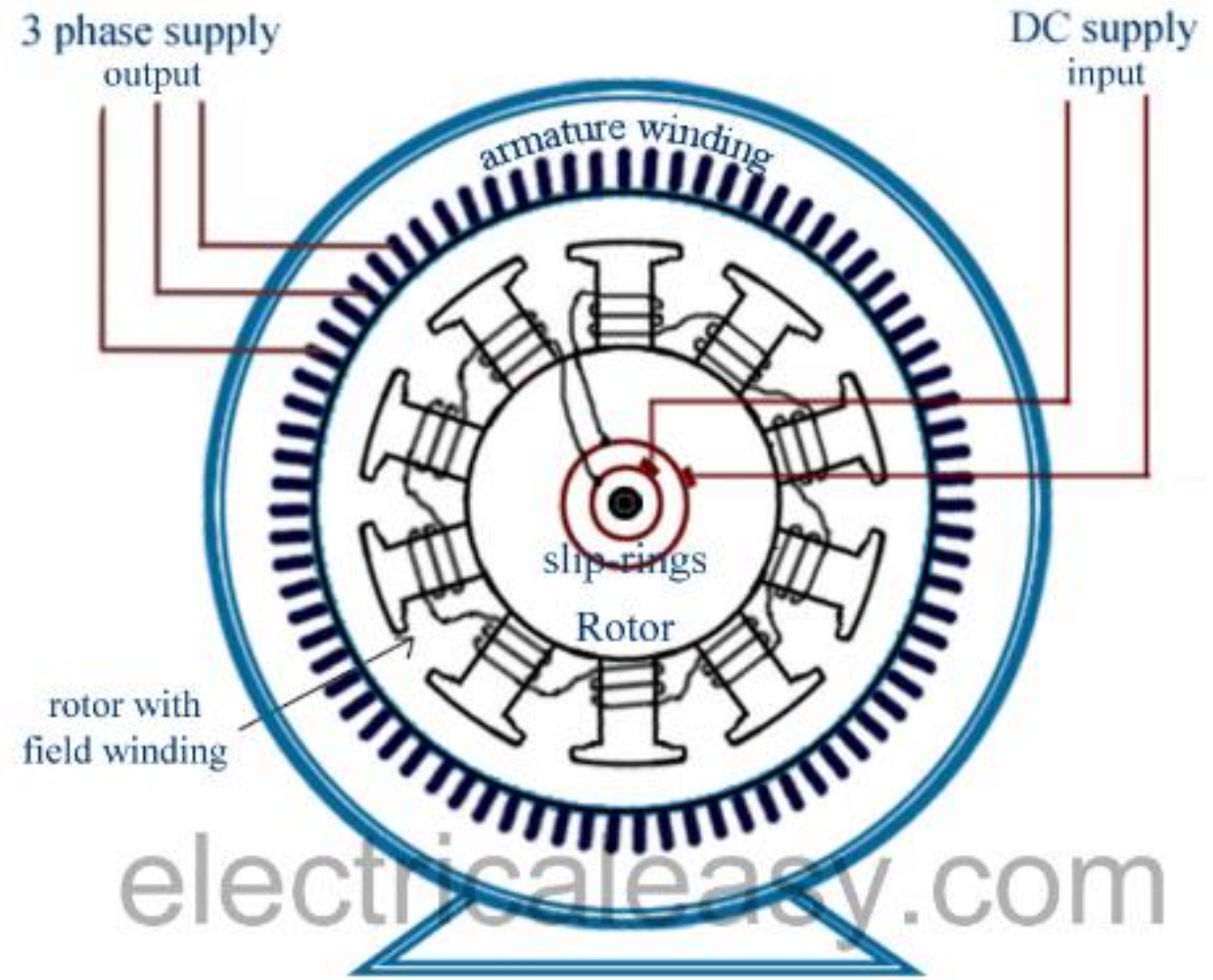
- Diesel Engine
- Steam Turbine
- Small petrol engine

Alternator:
 $P_{in} = P_{out} + \text{Losses}$

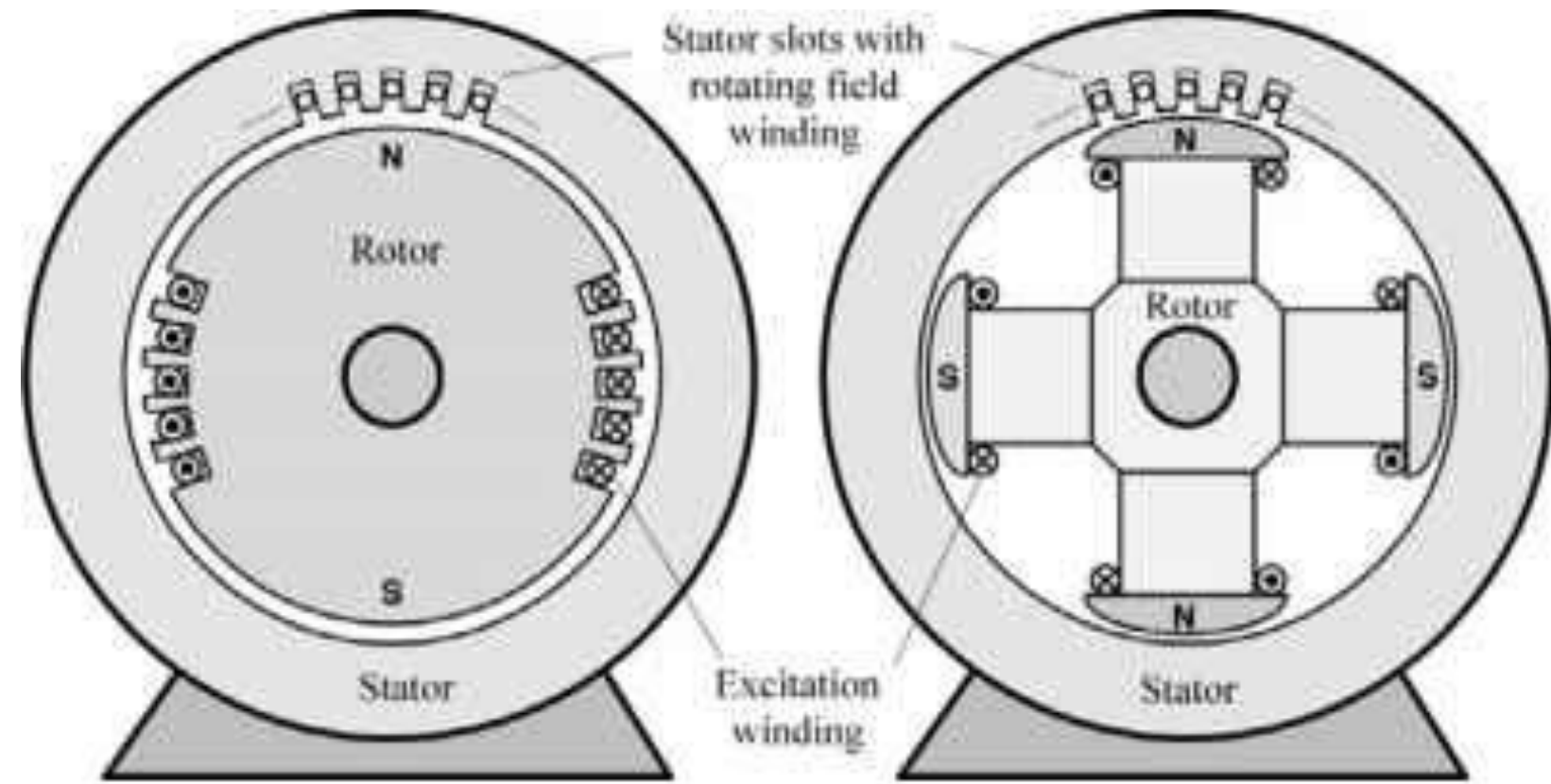
Alternator:

$$\text{Eff}\% = \frac{P_{out}}{P_{in}} \times 100$$

ALTERNATOR VS GENERATOR



ALTERNATOR-ROTOR TYPES



Cylindrical Rotor

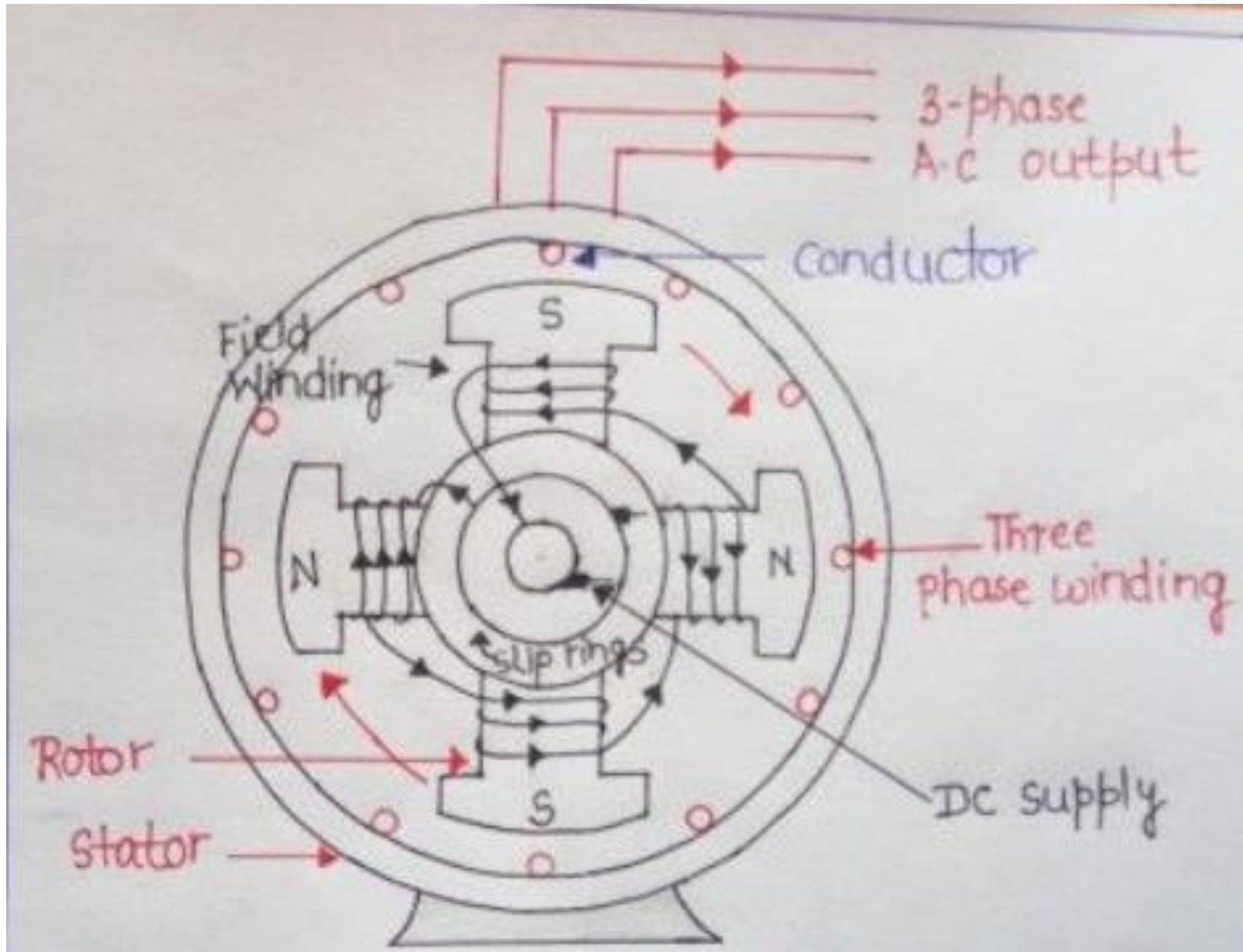
Salient Pole Rotor

The cylindrical rotor is also known as a non-salient rotor or round rotor and this rotor is used for high-speed machines approximately **1500-3000 rpm** and the example for this is a thermal power plant.

The meaning of the salient is projecting outward, which means the poles of the rotor are projecting outward from the center of the rotor. There is a field winding on the rotor and for this field winding will use DC supply.

The salient pole rotor used for low-speed machines approximately **115-400rpm**.

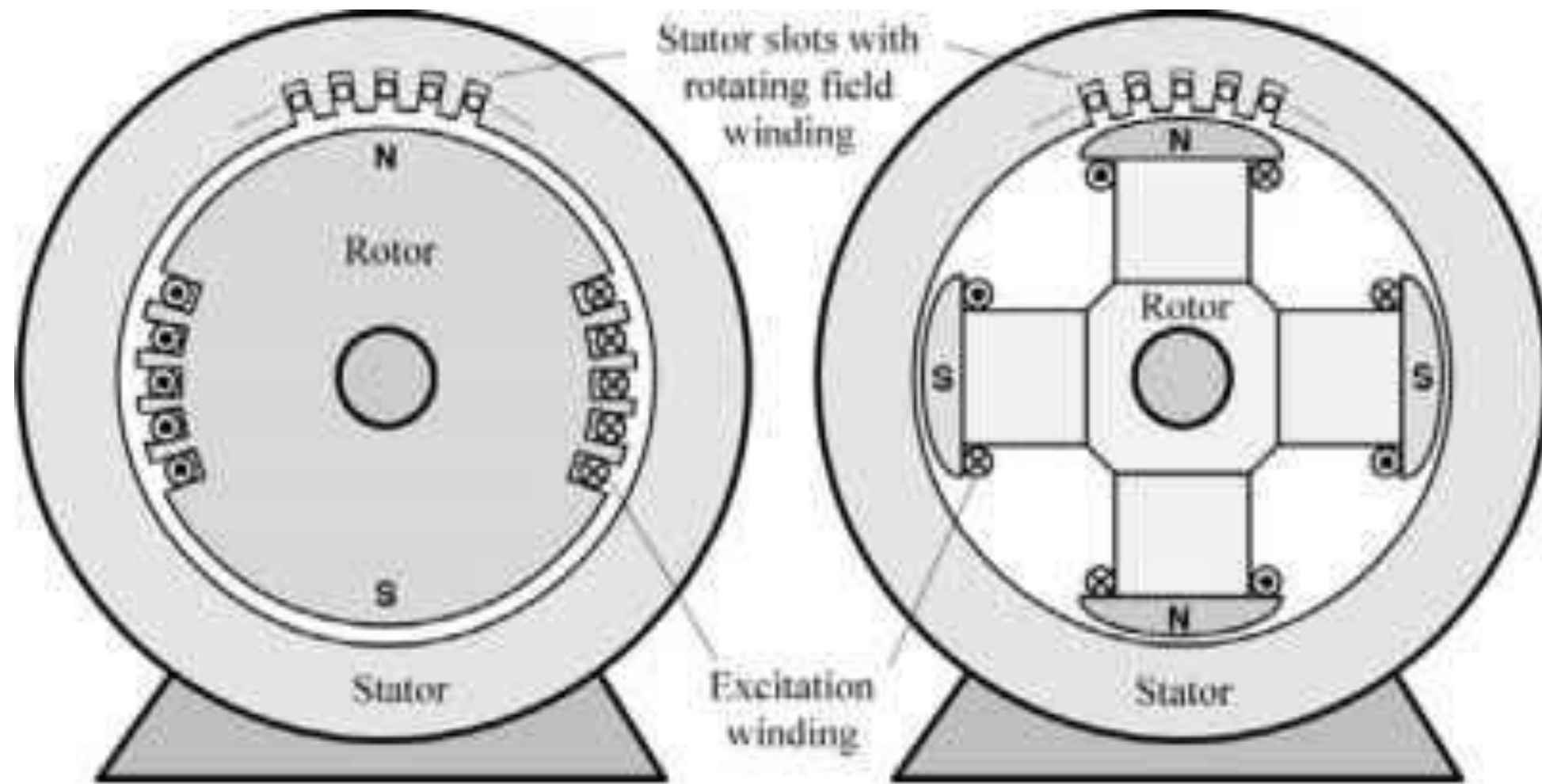
ALTERNATOR



WHY ARMATURE WINDING IS IN STATOR AND FIELD WINDINGS IN ROTOR?



The high voltage output can be directly taken out from the stationary armature. Whereas, for a rotary armature, there will be large brush contact drop at higher voltages, also the sparking at the brush surface will occur.



Cylindrical Rotor

Salient Pole Rotor

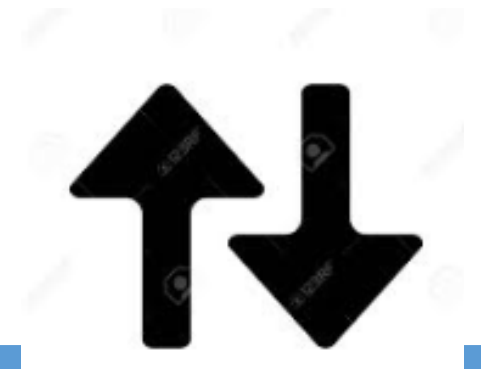
1. To accommodate larger number of poles, **SALIENT** Pole construction is well suited.

2. For high speed prime mover **CYLINDRICAL** construction is well suited

3. Why Salient pole is not used for high speed generator?



COMPARISON



SALIENT POLE	CYLINDRICAL/NON SALIENT TYPE
Salient pole rotors have large diameter and shorter axial length.	They are smaller in diameter but having longer axial length.
They are generally used in lower speed electrical machines, say 100 RPM to 1500 RPM.	Cylindrical rotors are used in high speed electrical machines, usually 1500 RPM to 3000 RPM.
As the rotor speed is lower, more number of poles is required to attain the required frequency. ($N = 120f / P$). Typically number of salient poles is between 4 to 60.	Number of poles is usually 2 or 4.
Flux distribution is relatively poor than non-salient pole rotor, hence the generated emf waveform is not as good as cylindrical rotor.	Damper windings are not needed in non-salient pole rotors.
Salient pole synchronous generators are mostly used in hydro power plants.	Non-salient pole rotors are used in nuclear, gas and thermal power plants.

ALTERNATOR TYPES

Alternators can be also classified as :

Based on output power

1. Single Phase
2. Three Phase

Based on the working principle

1. Revolving armature type
2. Revolving field type

Based on the speed on rotation

1. Turbo alternator
2. Low speed alternator

Based on coiling

1. Air cooling
2. Hydrogen cooling

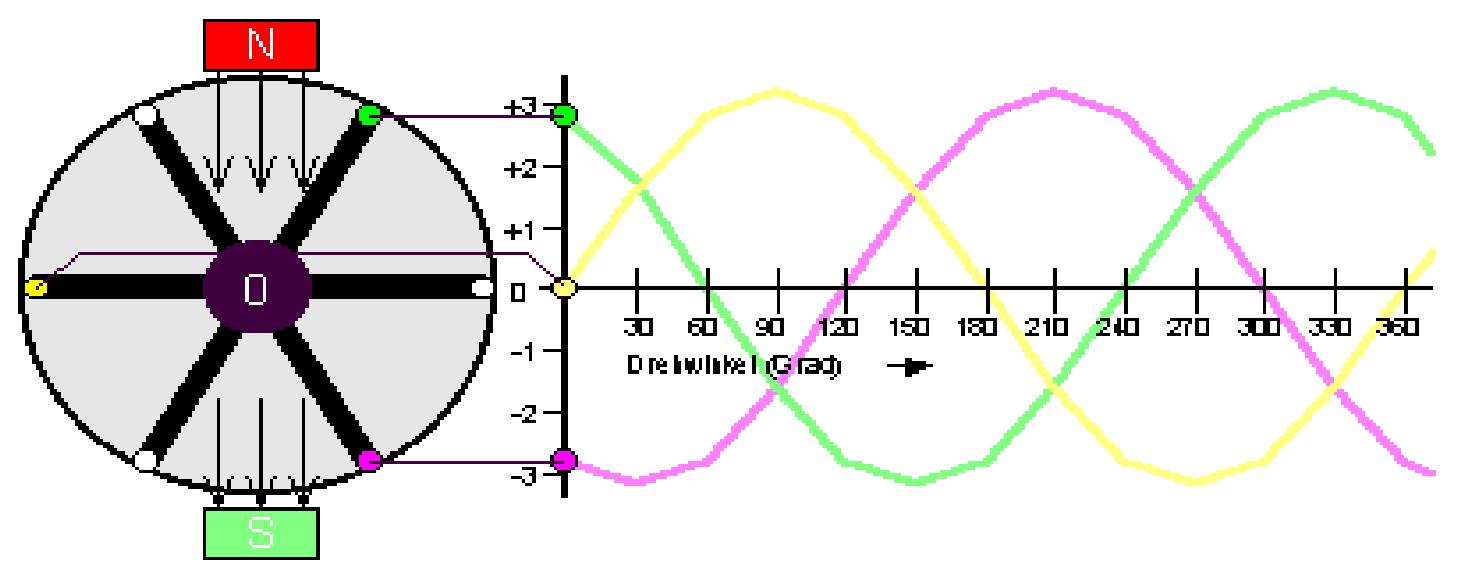
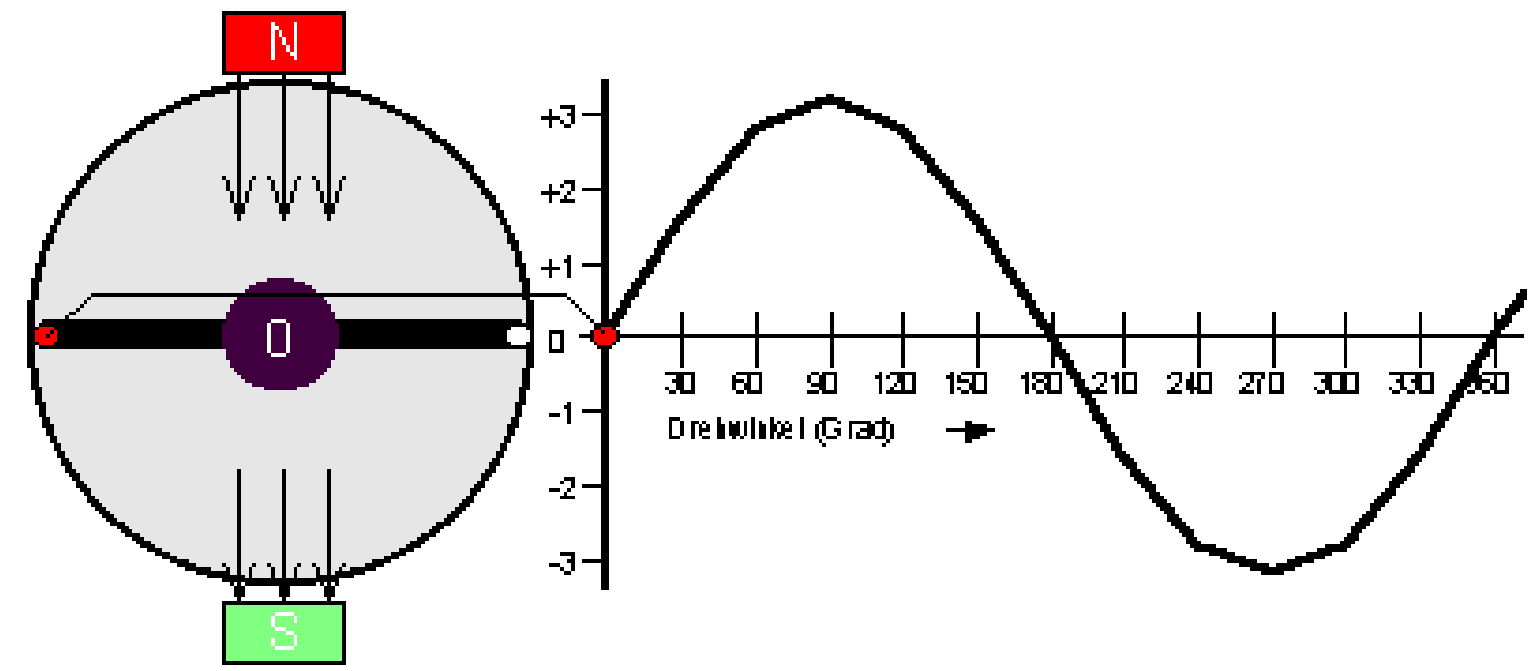
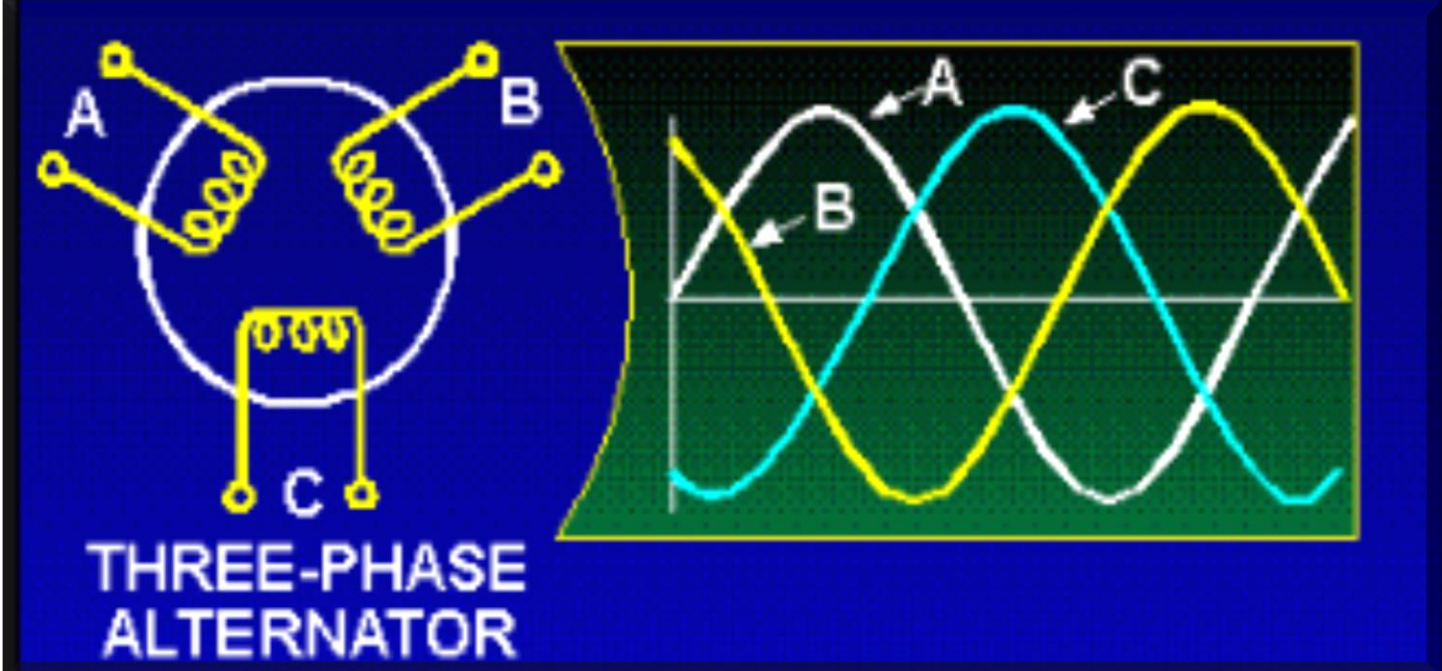
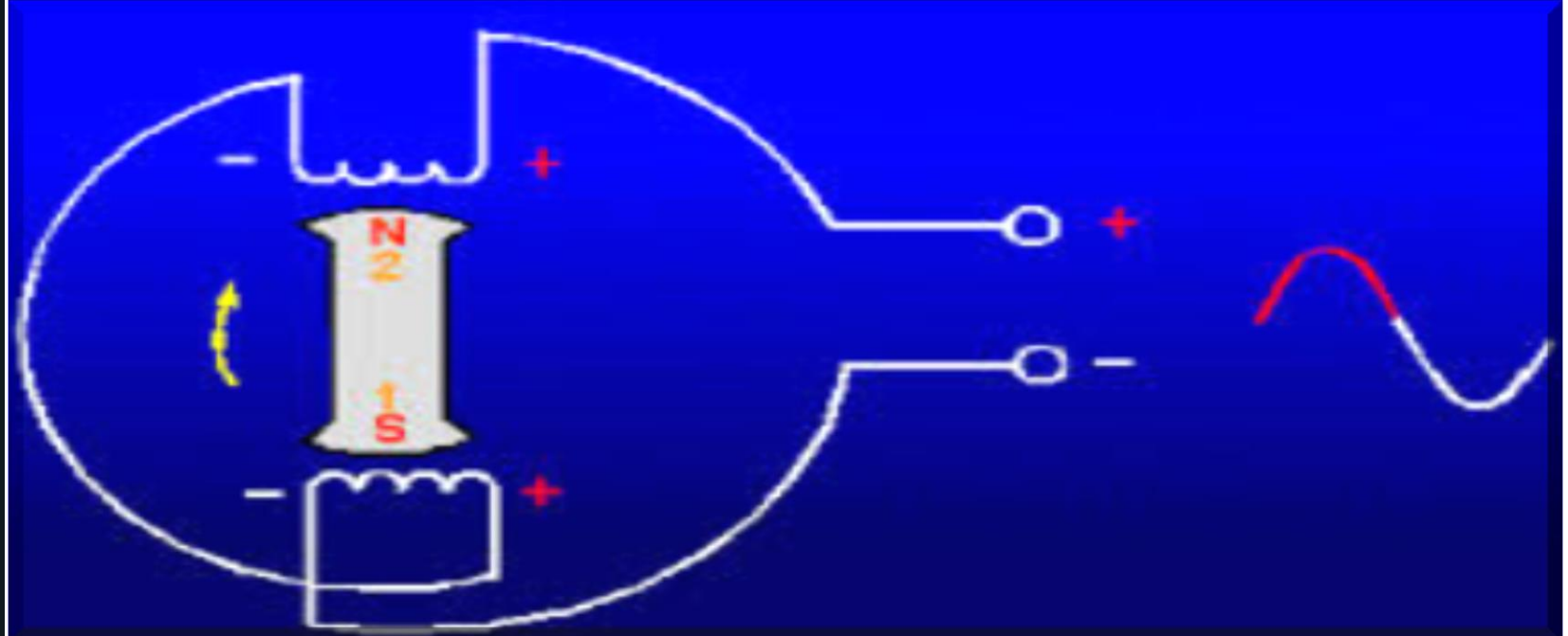
$$N=120F/P$$

N-SYNCHRONOUS SPEED

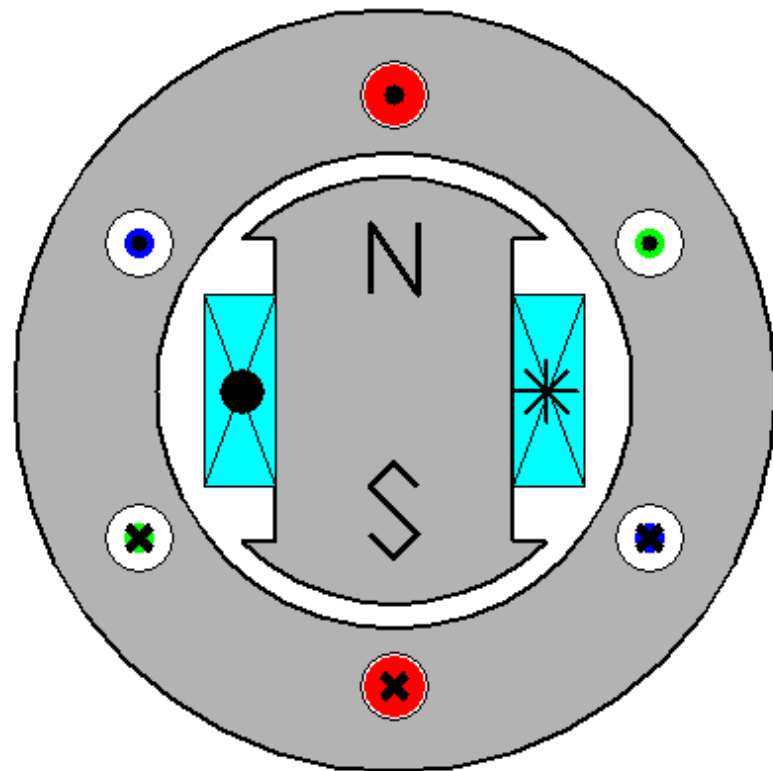
F-SUPPLY FREQUENCY

P-No of POLES

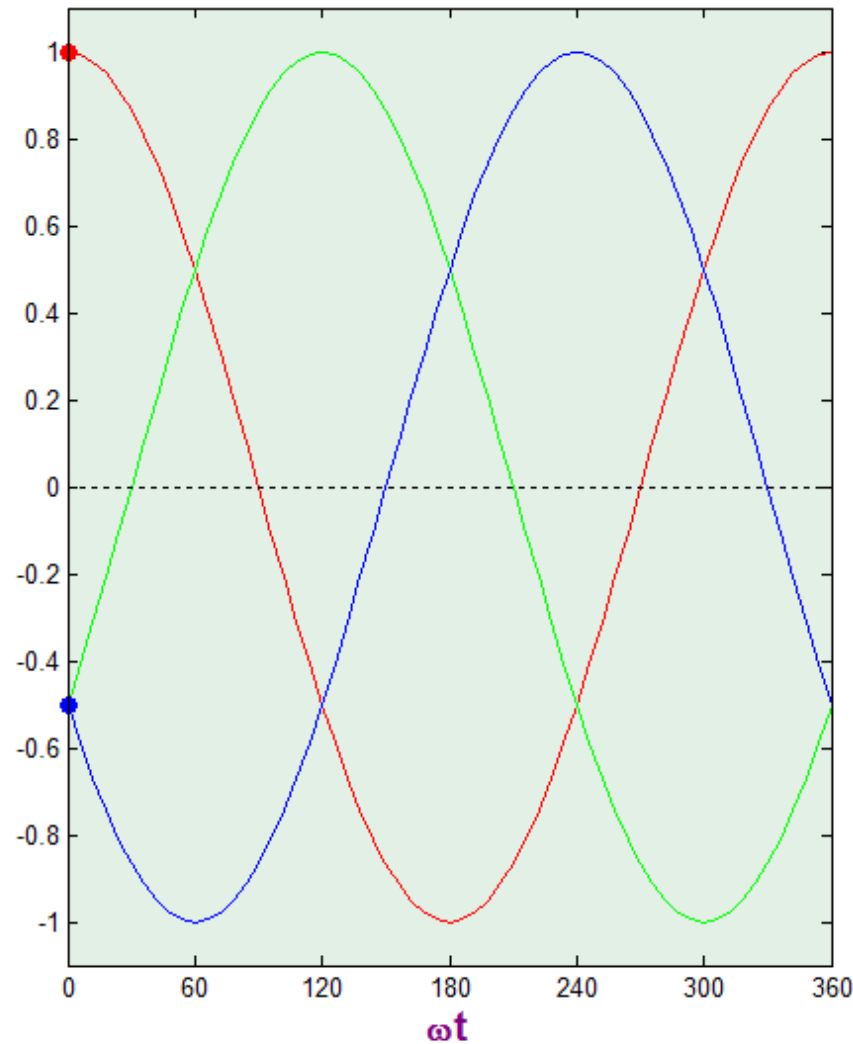
SINGLE PHASE VS THREE PHASE ALTERNATOR



THREE PHASE ALTERNATOR



Phase A
Phase B
Phase C



The elementary 3-phase 2-pole synchronous generator has a stator equipped with 3 coils displaced 115° from each other; although shown as concentrated, they actually are distributed.

When the rotor is excited with dc and rotated, the resultant field will also rotate so that sinusoidal voltages are generated in the 3 stator phases, displaced 115° in time and having a frequency directly related to rotor speed.

ALTERNATOR

APPLICATIONS

- The applications of an alternator are Automobiles
- Electrical power generator plants
- Marine applications
- Diesel electrical multiple units
- Radiofrequency transmission

ADVANTAGES

The advantages of an alternator are

- Cheap
- Low weight
- Low maintenance
- Construction is simple
- Robust
- More compact

DISADVANTAGES

The disadvantages of an alternator are

- Alternators need transformers
- Alternators will overheat if the current is high

*Thank
You*