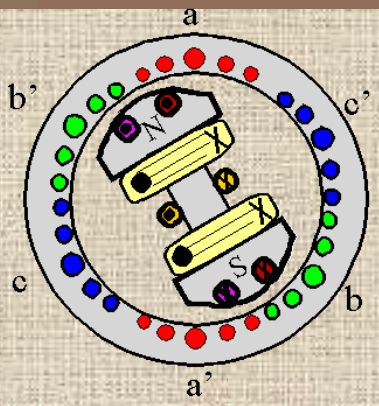
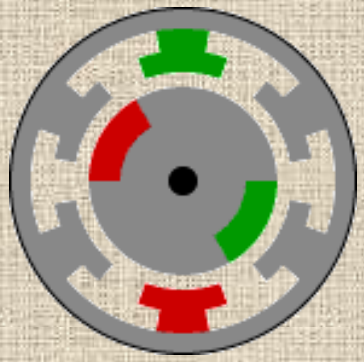
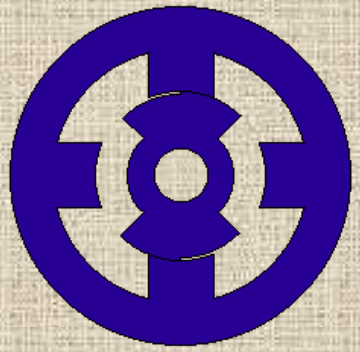
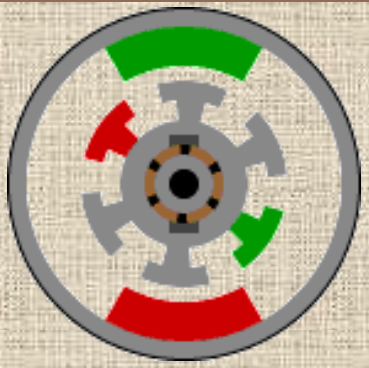
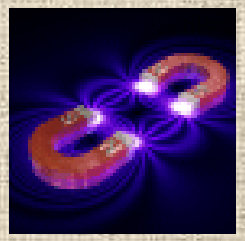




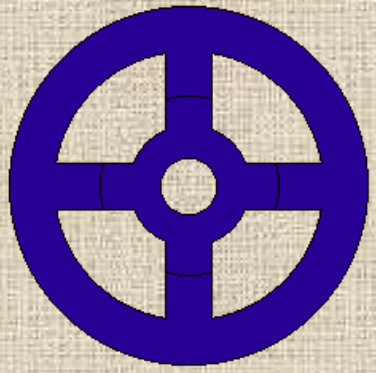


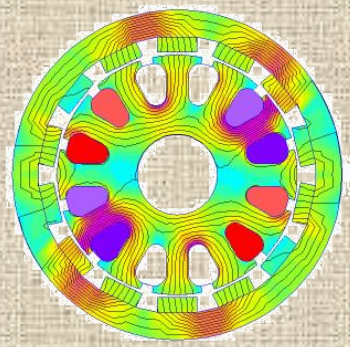


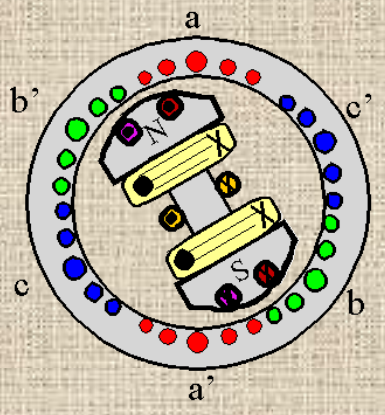
EE552 ELECTRICAL MACHINES III

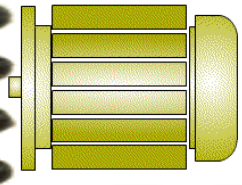


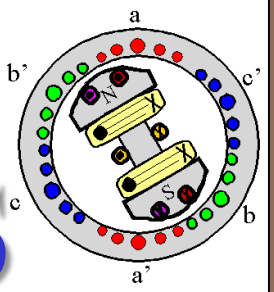
LECTURE 6





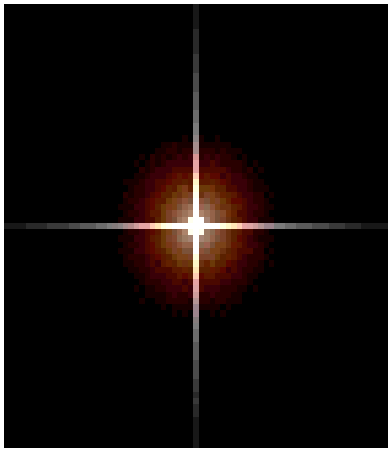




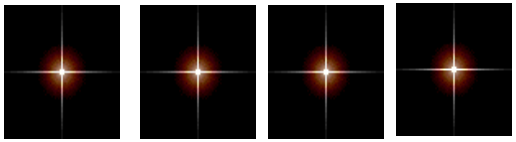


LECTURE NOTES

ELECTRICAL MACHINES III



EE552



SPRING 2018

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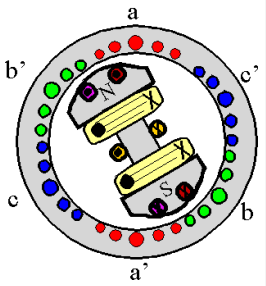
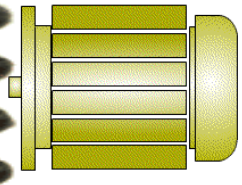
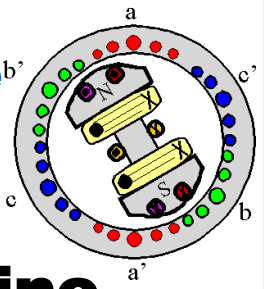


LECTURE 6

SYNCHRONOUS MACHINES

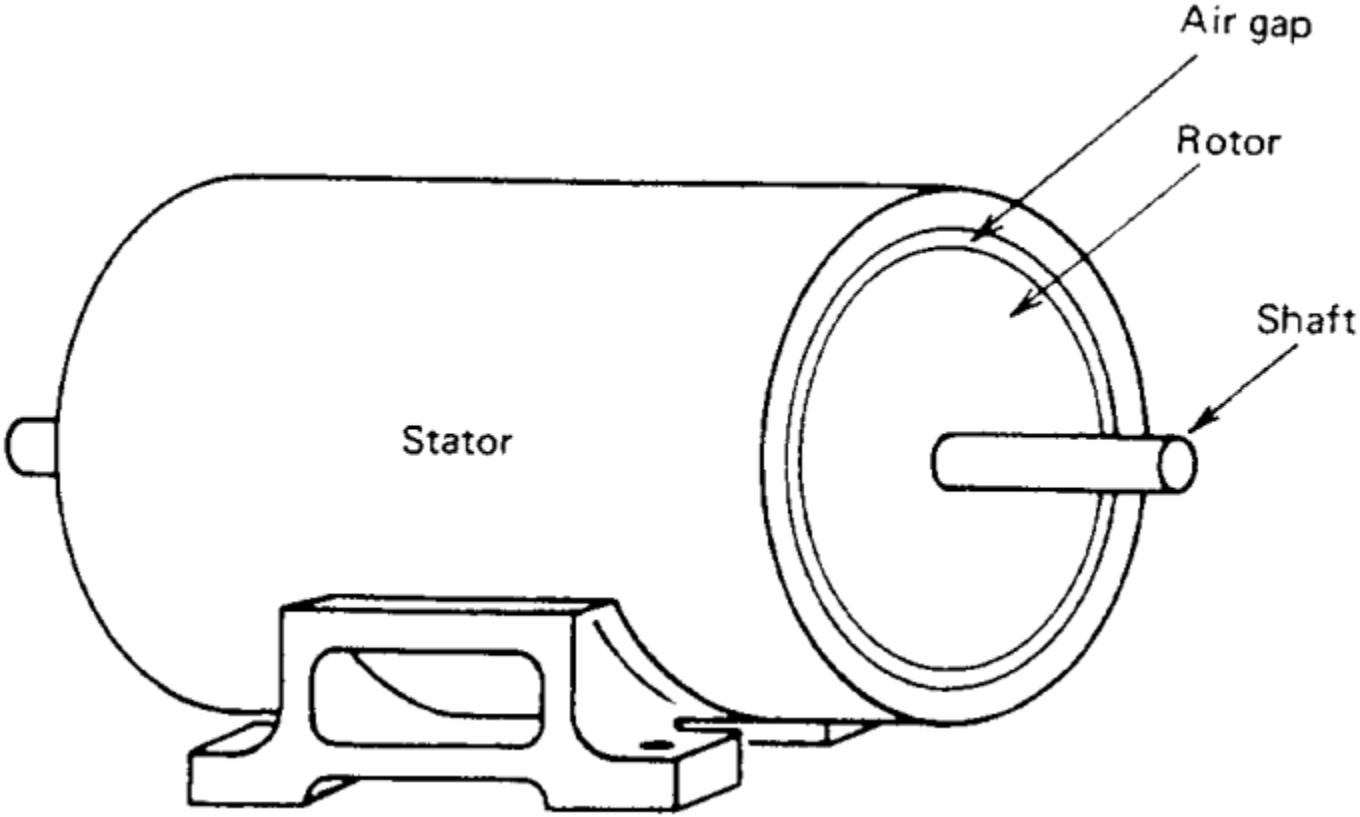


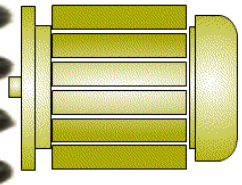
Basic Concepts of A electrical Machine



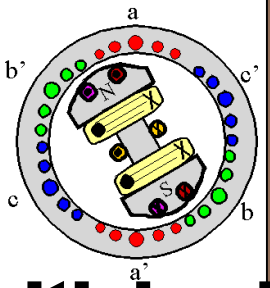
Stator: stationary portion of the machine

- **Rotor: rotating portion of the machine**
- **Shaft: the stiff rod that the rotor is**

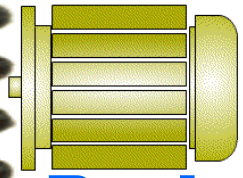




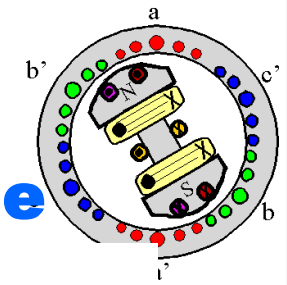
Basic Concepts of A electrical Machine



- ❑ **Load current: the current that varies with load**
- ❑ **Magnetizing current: provide magnetic field and independent of load**
- ❑ **Armature: the winding that carries only load current**
- ❑ **Field: the winding that carries only magnetizing current**
- ❑ **dc machine: the input/output current is D.C.**
- ❑ **ac machine: the input/output current is A.C; two categories:**
  - ➢ **synchronous machine**
  - ➢ **induction machine (no field winding, similar to transformer)**

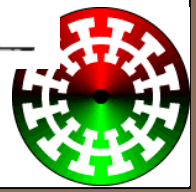


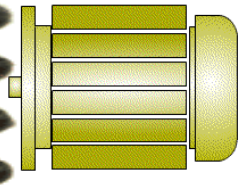
Basic Concepts of A electrical Machine



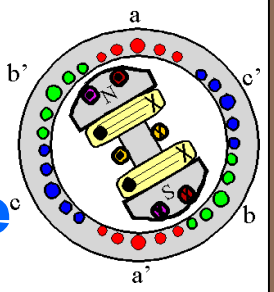
Winding Terminology

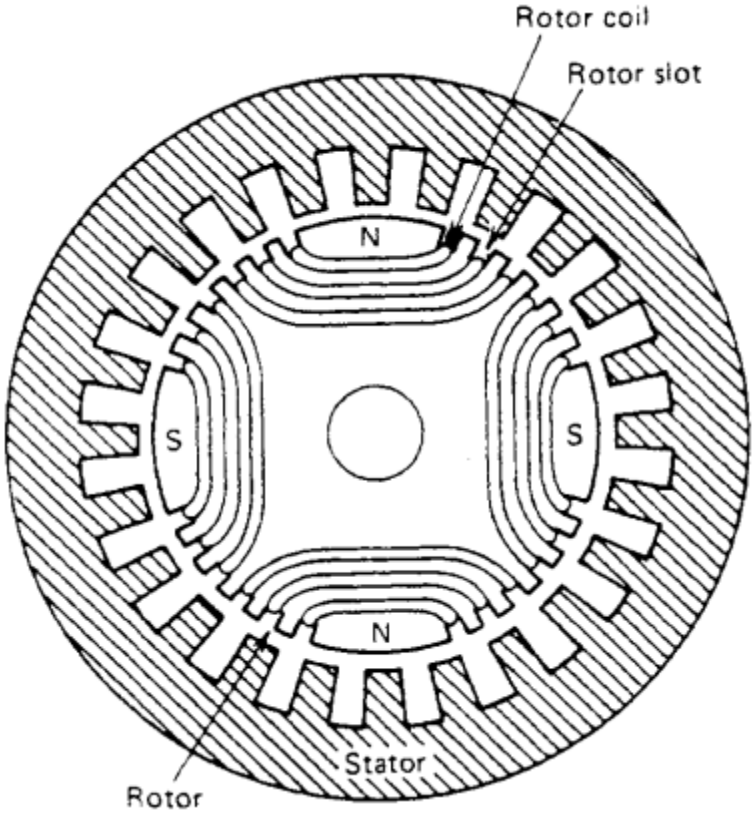
Device	Winding Function	Winding Term	Location	Current Type
Synchronous machine	Input/output Magnetizing	Armature Field	Stator Rotor	ac dc
dc machine	Input/output Magnetizing	Armature Field	Rotor Stator	ac in winding dc at brushes dc
Induction machine	Input Output	Primary Secondary	Stator Rotor	ac ac
Transformer	Input Output	Primary Secondary		ac ac



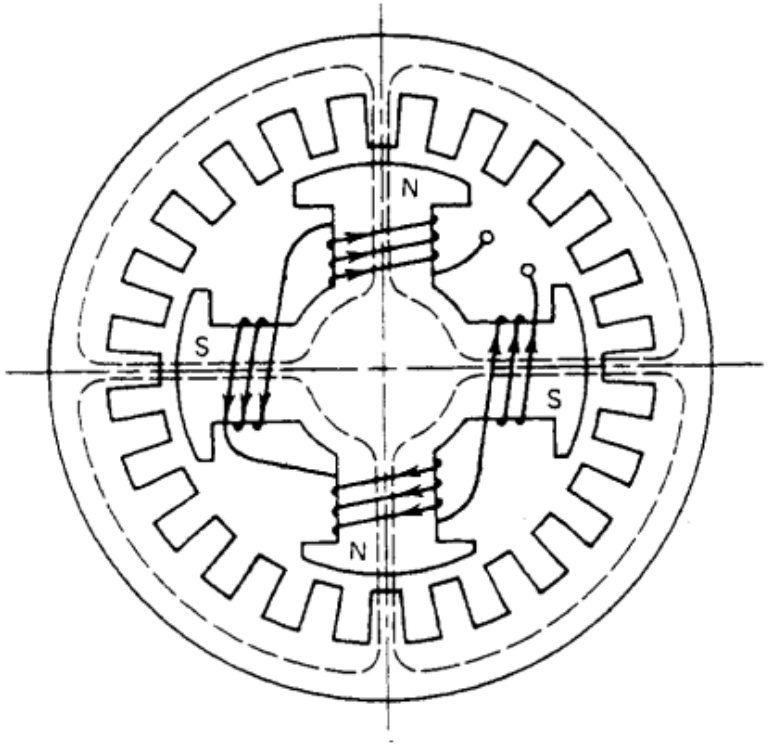


Basic Concepts of A electrical Machine

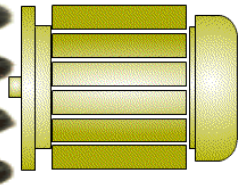




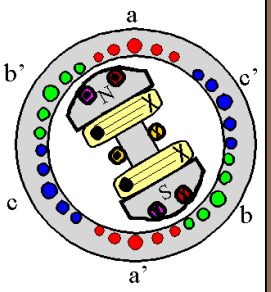
round rotor

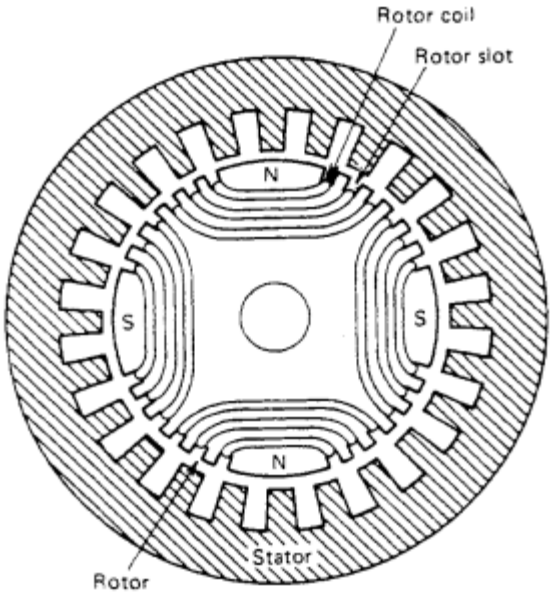


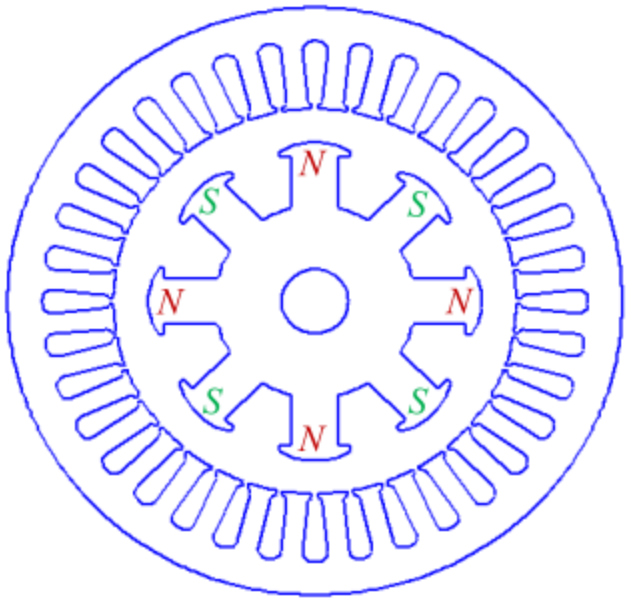
salient pole rotor



Electrical vs Mechanical Frequency



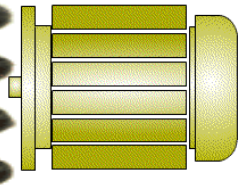




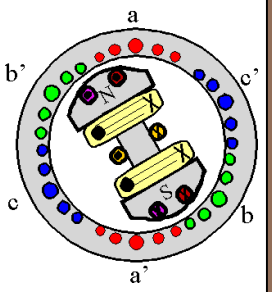
At steady state $f_e = \frac{P}{2} f_m$

mechanical speed n_m revolution/minute (rpm)

$$f_m = n_m \frac{1}{60} = \frac{n_m}{60} \quad \text{rev/second}$$

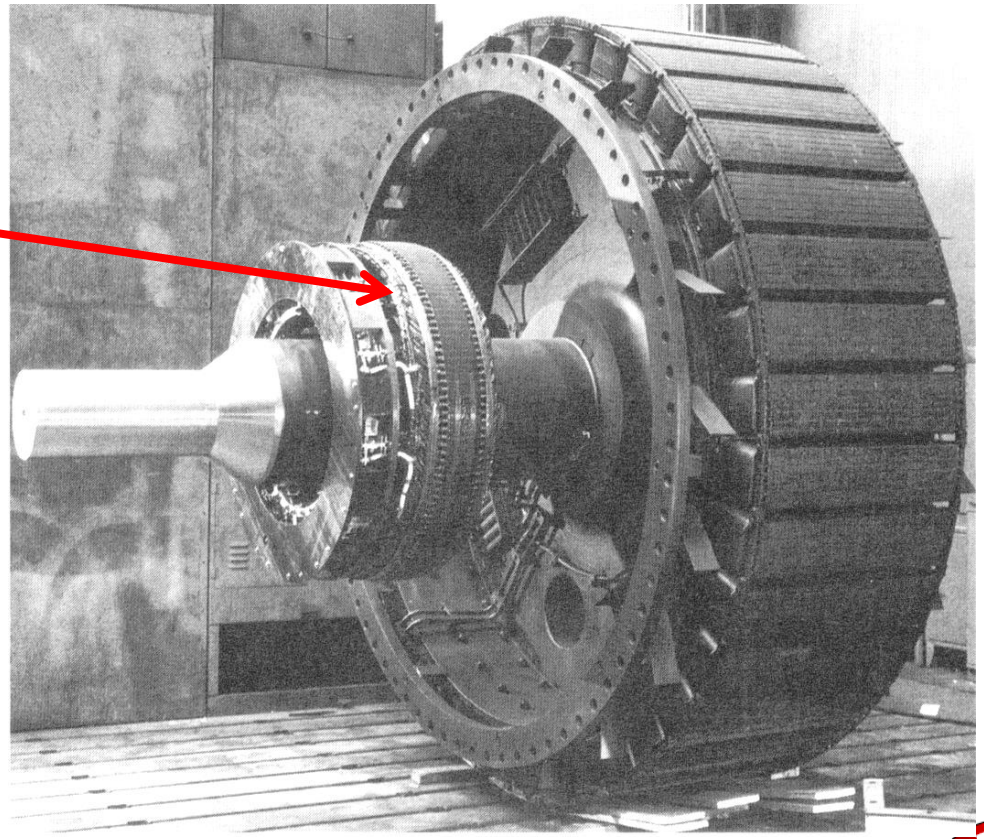


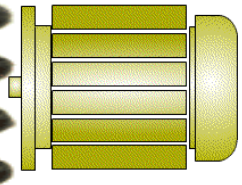
Construction of synchronous machines



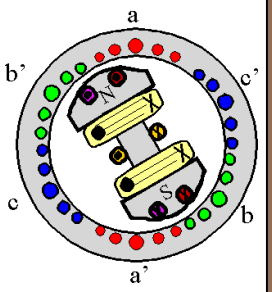
A rotor of large synchronous machine with a brushless exciter mounted on the same shaft.

Many synchronous generators having brushless exciters also include slip rings and brushes to provide emergency source of the field DC current.

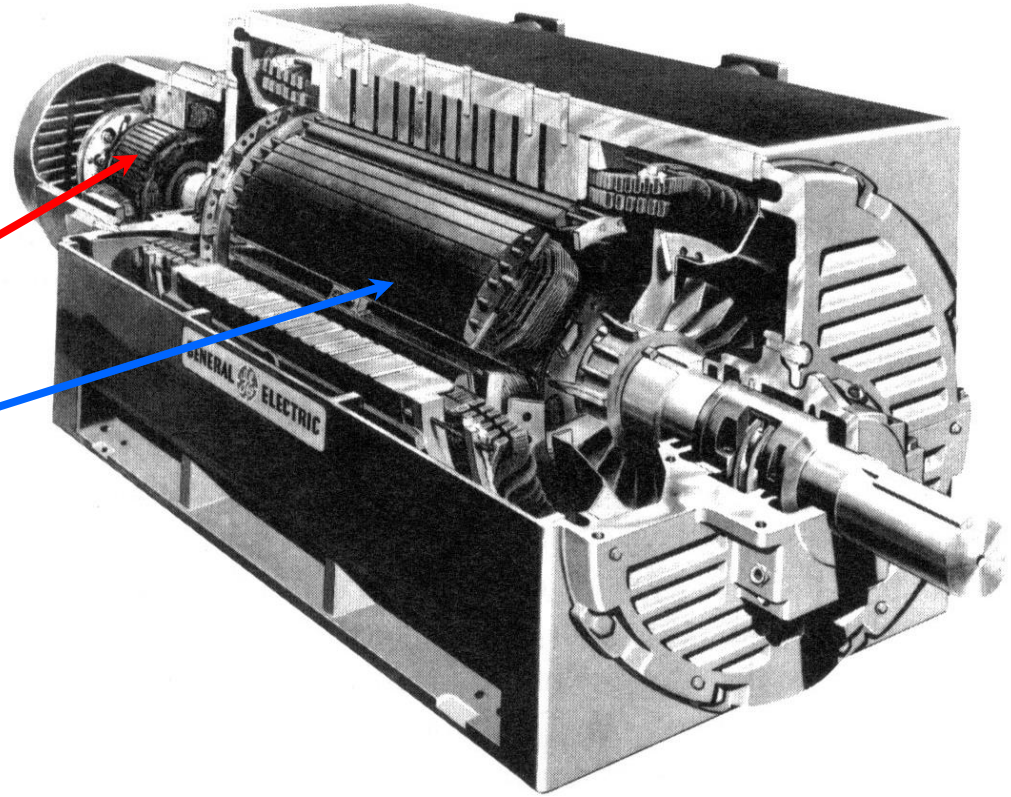


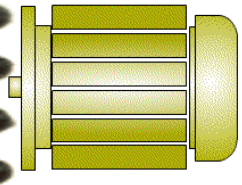


Construction of synchronous machines

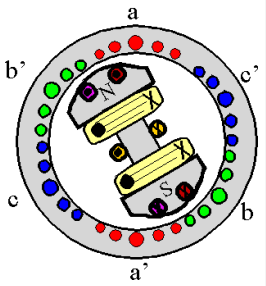


A large synchronous machine with the exciter and salient poles.

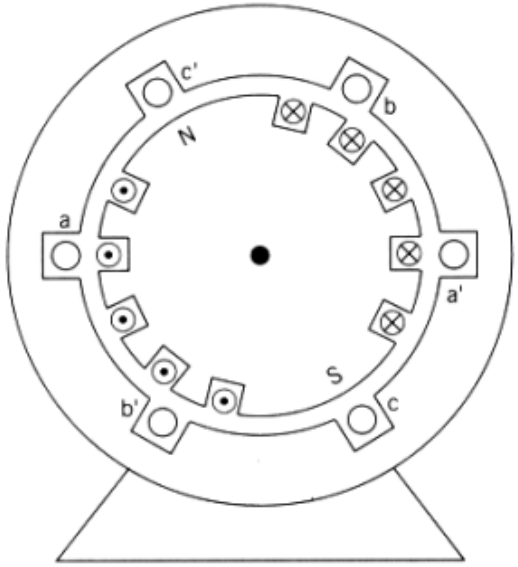




Cylindrical Rotor

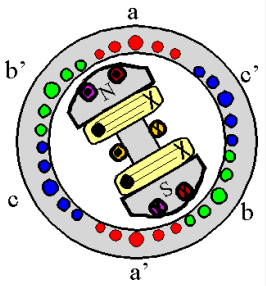


- Designed with 2 or 4 poles for high speed operation
  - 3600 rpm for two pole machine at 60 Hz machine at 60 Hz
- Centrifugal forces limit rotor diameter
- High power, high speed rotors (for 1000 – 1500 MVA) tend to be very long



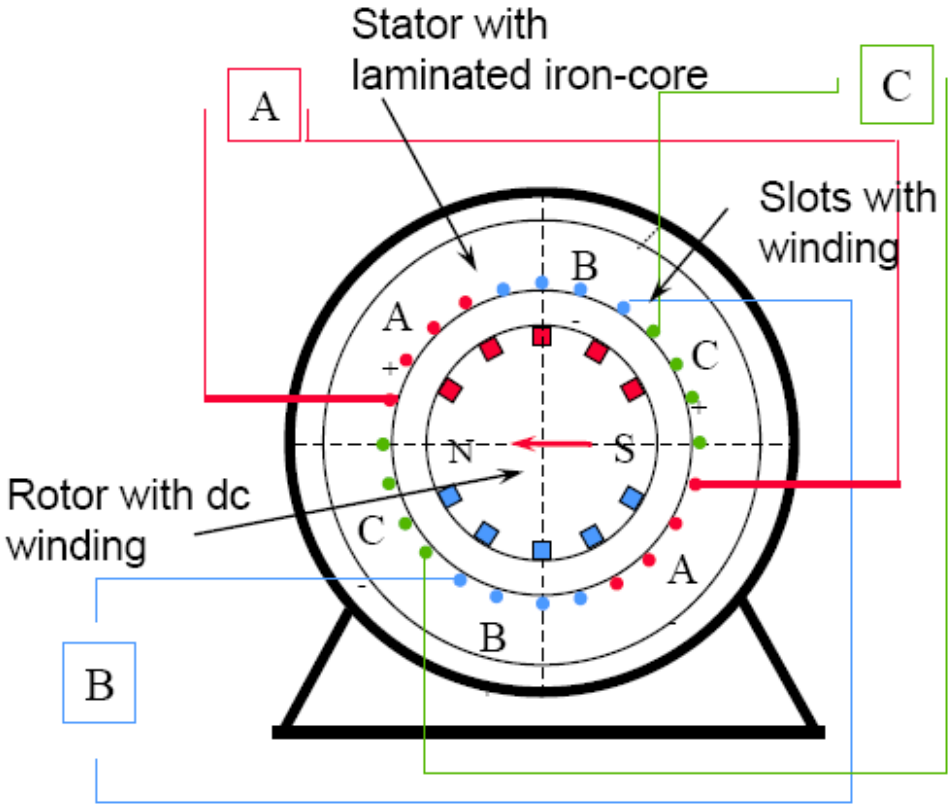
Cylindrical Rotor Synchronous Machine

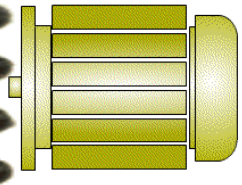
Synchronous Machine



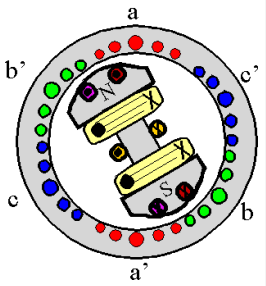
- **Round Rotor Machine**

- **The stator is a ring shaped laminated iron-core with slots**
- **Three phase winding are placed in the slots.**
- **Round solid iron roto with slots.**
- **A single winding is placed in the slots. Dc current is supplied through slip rings.**

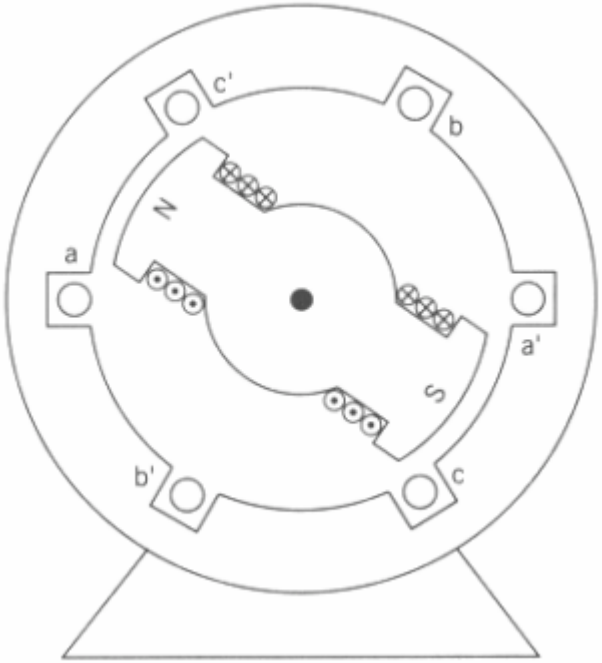




Salient Pole Rotors

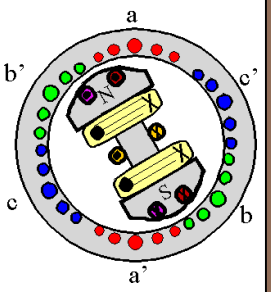


- Low speed, multi-pole generators
- Large diameter to accommodate poles
- May be equipped with squirrel cage damper winding
- Significant variation in reluctance of air-gap

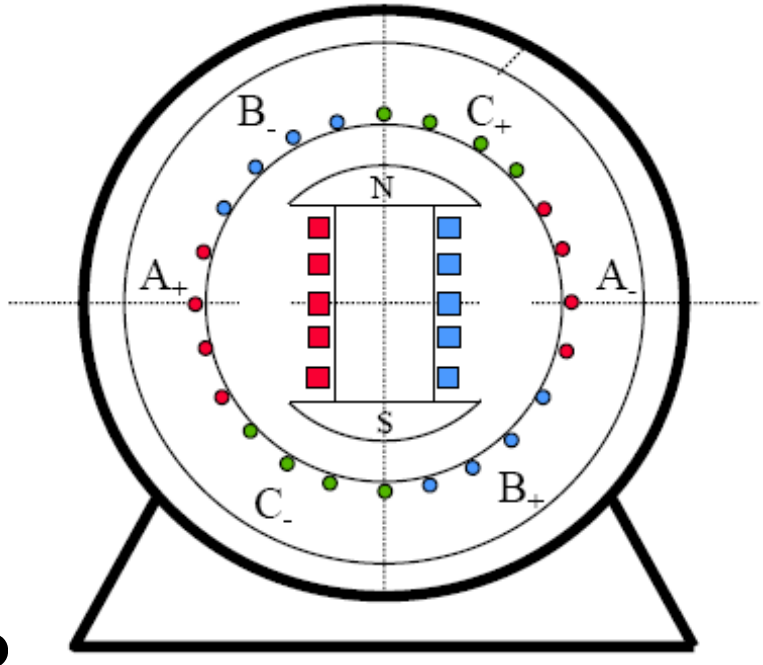


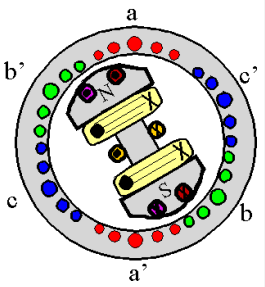
Salient Pole Rotors Synchronous Machine

Synchronous Machine

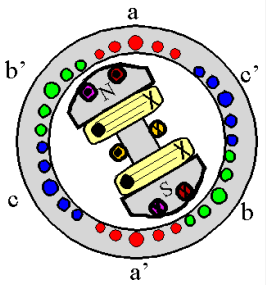


- **Salient Rotor Machine**
- **The stator has a laminated iron-core with slots and three phase windings placed in the slots.**
- **The rotor has salient poles excited by dc current.**
- **DC current is supplied to the rotor through slip-rings and brushes.**




a
b'
c'
N
S
c
b
a'


PresenterMedia


a
b'
c'
c
b
a'
N
S

END OF BLECTURE 6