

Aim: Study the following things about DC Machine:

1. Commutator - brush arrangement.
2. Torque Speed Characteristic of separately excited.

Theory:

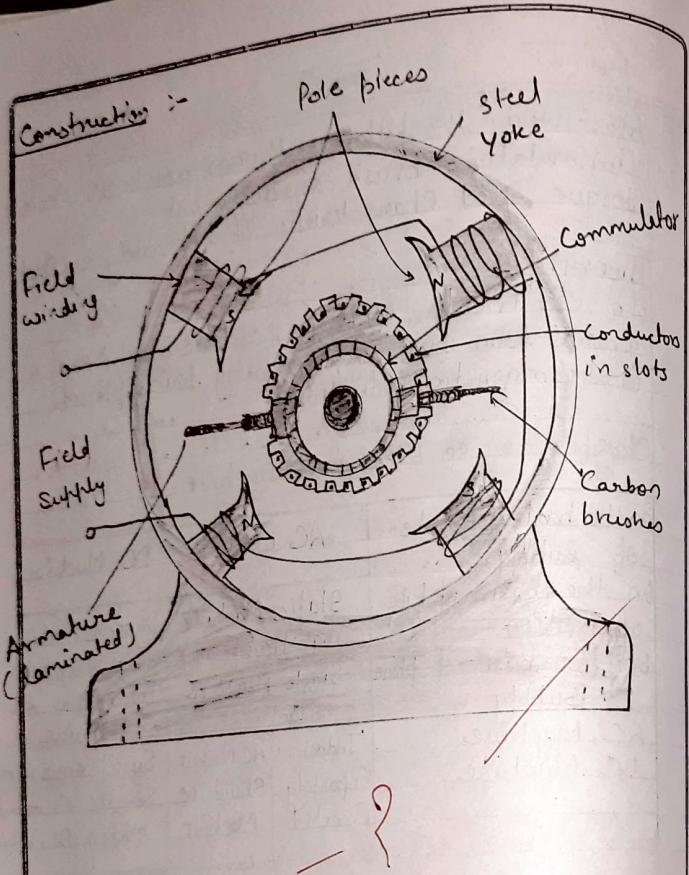
In Electrical engineering, electric machine is a general term for machines using principle of electromagnetic induction.

Classification of Electrical machine:

On the basis of type of supply.	AC Machine	DC Machine
On the basis of type of motion	Static Machine e.g. Transformer	Dynamic Machine e.g. Generator, Motor
On the basis of phase of supply	Single Phase AC Machine	Three Phase AC Machine
AC Machine	Induction AC Machine	Synchronous AC machine
DC Machine	Separately Excited	Shunt DC Machine
		Series DC Machine
		Compound DC Machine

DC Machine

Working Principle:



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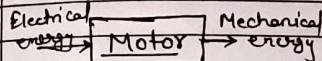
Page No.

Date

Motor

An electric motor converts electricity to mechanical power

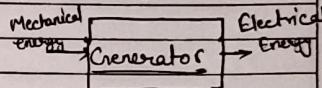
Energy conservation



Generator

An electric generator converts mechanical power of electricity to electricity

Energy conservation



~~When a current carrying coil placed in an external magnetic field, it will experience a force by magnetic field~~

~~When a relative motion b/w a magnet field and a coil or conductor, then an EMF will induce across that coil or conductor.~~

Some of the parts of the DC machine are discussed below:

Yoke

- Yoke is the outer frame
- Offer mechanical support intended for poles and protects the entire machine from moisture, dust, etc.
- Materials used in the yoke are designed with cast iron, cast steel otherwise rolled steel.

Pole and Pole core:

- Pole is an electromagnet.
- The field winding is winding among pole core.
- Built with the annealed steel laminations for reducing eddy currents.
- Cast steel, cast iron materials used.

Pole shoe:

- Spread out flux within the air gap (a air space between stator and rotor)
- Materials used in the Pole shoe are designed with cast iron, cast steel otherwise rolled steel.

Field windings:

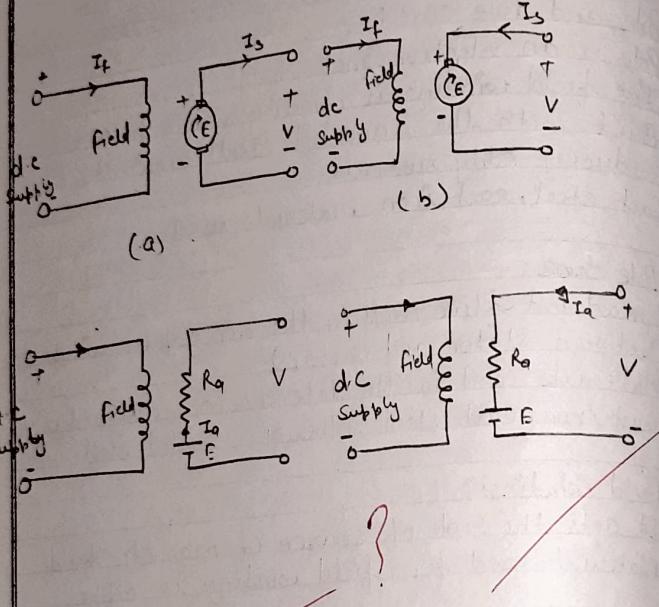
- It acts the role of source of magnetic field.
- Material used for field windings is copper.

Armature core:

- It is a rotating part
- Lamination is used to make it
- Cast steel, cast iron materials used
- Armature core includes a huge number of slots within its edge.

Armature windings:

- It acts the role of conductor.



Expt. No.

Page No.

Date

- Material used for field windings is copper.
- Placed in armature slot.

Commutator:

- Main function is to collect the current from the armature conductor as well as supplies the current to the load using brushes.
- Built with a huge number of segments in the edge form of hard drawn copper.

Brushes:

- Gather the current from the commutator and supply it to the exterior load.
- Materials used in brushes are graphite otherwise Carbon.

Equivalent Circuit:

Fig (a) shows equivalent circuit of DC generator and Fig (b) shows equivalent circuit of DC motor.

from fig (a) $E = V + I_a R_a$ Generator equation

from fig (b) $V = E + I_a R_a$ Motor Equation

Viva - Questions

Q.1 What is separately excited DC motor?

Ans: A separately excited dc motor is a motor whose field circuit is supplied from a separate constant voltage power supply, while a shunt dc. motor is a motor whose field circuit gets its power directly across the armature terminals of the motor.

Q.2 What is self-excited DC motor?

Ans: Self excited DC motor. In case of self-excited DC motor, the field winding is connected either in series or in parallel or partly in series, partly in parallel to the armature winding. Based on this, self-excited DC motor can be classified as: Shunt wound DC motor.

Q.3 What is back emf in dc motor?

Ans: The voltage produced across the armature is known as counter or back emf. The Back EMF in the DC motor is expressed by the following mathematical expression. The back EMF is proportional to the speed of the motor. It governs the armature current and thus the back EMF maintains the speed and torque of the motor.

Q.4. What is flux in a DC motor?

Ans: DC motor consists of two parts i.e. rotor and stator. When both armature and field are excited by DC supply, current flows through windings and magnetic flux proportional to the current is produced. When the flux of field interacts with the flux of armature, it results in motion of the rotor.

Q.5. What are the characteristics of DC motor?

Ans: The most important characteristic of a dc motor is the inverse relationship between its torque and speed. That is, at low speed torque is high and at high speed torque is low. So, it has a high starting torque which makes it suitable for applications where the motor has to start against a heavy load e.g. in traction.

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