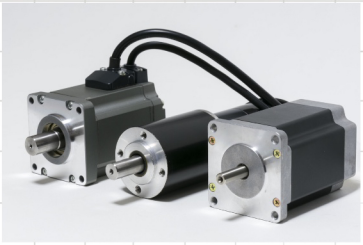
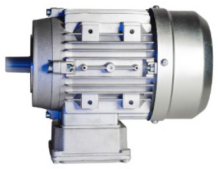
ELECTROMAGNETICS

Unit 4
Session 3



Introduction to -
- AC DC Motors
- Working Principles and Characteristics
- Different Control of Motor

Lesson Aims:
1. Working principle of AC & DC
2. Identify different Motors Specifications
3. Classify types and Application



AC Motor

DC Motor

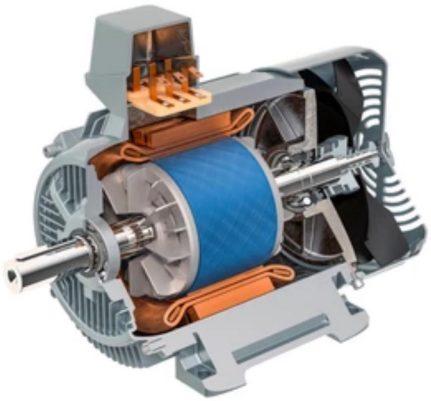
- What to know about Motors?
- What is the difference between AC & DC?
- What kind of motor is used in home appliances?

Brainstorming

Electric motors are machines that convert electrical energy—from either stored power or a direct electrical connection—into mechanical energy through the production of rotational force. The two major types of electric motors are AC motors, which are powered by alternating current
DC motors, which are powered by direct current

How Electric Motors Work

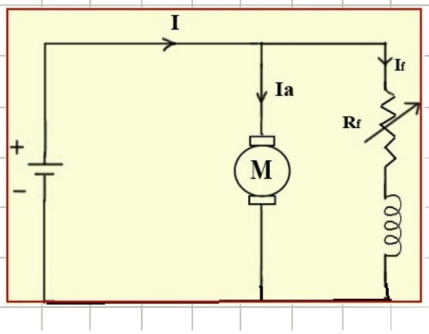
Both AC and DC motors use electrical current to produce rotating magnetic fields that, in turn, generate rotational mechanical force in the armature—located on the rotor or stator—around the shaft. The various motor designs use this same basic concept to convert electric energy into powerful bursts of force and provide dynamic speed or power levels.
AC and DC motors are broad categories of motors that include smaller subtypes. Induction motors, linear motors, and synchronous motors, for example, are all types of AC motors. AC motors can also include variable-frequency drives to control the motor's speed and torque, while DC motors are available in self-excited and separately excited-type models.

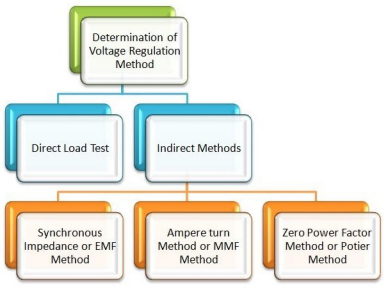


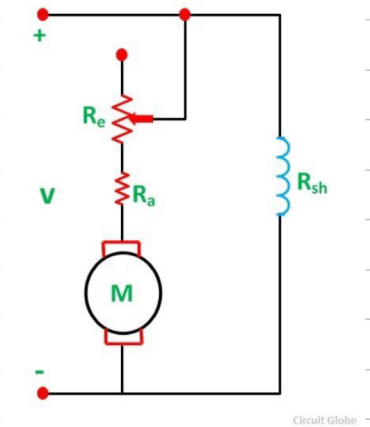
Types of Control:

AC / DC Motor Speed Control
- Speed Control of Induction Motor from Stator Side
- By Changing the Applied Voltage
- By Changing the Applied Frequency
- Constant V/F Control of Induction Motor
- Changing the Number of Stator Poles
  - Multiple Stator Winding Method
  - Pole Amplitude Modulation Method (PAM)

- Speed Control of Induction Motor from Rotor Side
- Rotor Rheostat Control
- Cascade Operation
- By Injecting EMF In Rotor Circuit







There are three main ways to achieve speed regulation in series DC motors–flux control, voltage control, and armature resistance control.

1. Flux Control Method

In the flux control method, a rheostat (a variable resistor) is connected in series with the field windings. The purpose of this component is to increase the series resistance in the windings which will reduce the flux, consequently increasing the motor's speed.

2. Voltage Regulation Method

The variable regulation method is typically used in shunt dc motors. There are, again, two ways to achieve voltage regulation control:
Connecting the shunt field to a fixed exciting voltage while supplying the armature with different voltages (aka multiple voltage control)
and Varying the voltage supplied to the armature (aka the Ward Leonard method)

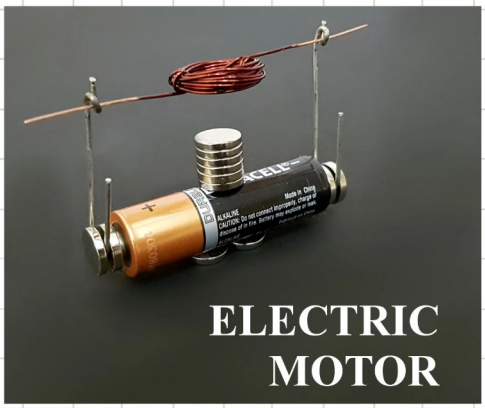
3. Armature Resistance Control Method

The armature resistance control is based on the principle that the speed of the motor is directly proportional to the back EMF. So, if the supply voltage and the armature resistance are kept at a constant value, the speed of the motor will be directly proportional to the armature current.

Activity

Build a Simple Electric Motor

1) To make a bundle, wrap the ends of the wire several times around the loops to hold them in place. Position the ends so they are direct across from each other and extend out in a straight line on either side of the bundle, to form an axle. What you just made is called the armature.
2) Hold the wire bundle you have made so that it would be flat against a wall, rather than a table, and color the top side of each wire end using the marker. Leave the bottom side of each wire bare.
3) Carefully bend each paperclip, forming a small loop by wrapping one end around a small object such as a pencil or pen. Thick wire and pliers may be used instead of a paper clip if you want. Be sure to use caution when using the pliers.
4) If you are using a battery holder, attach a paper clip to either side and insert the battery. If you don't have a battery holder, wrap the rubber band tightly around the length of the battery. Insert the paper clips so each one is touching one of the terminals, and they are securely held by the rubber band. Attach the curved side of the battery firmly to a table or other flat surface using clay or sticky tack.
5) Set one neodymium magnet on top of the battery, in the center. Position the armature in the paper clip loops, with the shiny, uncolored side touching the paper clips. Make sure it doesn't touch the magnet.
6) If your motor doesn't start immediately, try giving it a start by spinning the wire bundle. Since the motor will only spin in one direction, try spinning it both ways.
7) If your motor still is not working, make sure that the paper clips are securely attached to the battery terminals. You may also need to adjust the insulated wire so both ends are straight, and the bundle you have made is neat, with the wire ends directly opposite each other.
8) With the motor spinning, hold up the other magnet, above the armature. As you move it closer, what happens? Turn the magnet over and try again to see what happens..



Reflection

1) What is the meaning of winding?
2) How can you differentiate an AC motor from a DC motor?
3) Are there any advantages of an AC motor over a DC motor, If Yes, What are those and How?
4) What is motor & Types?
5) What are the 3 types of AC motors?
6) What do you mean by a DC motor?
7) How does a 3-phase AC motor & DC motor work?

For more information -