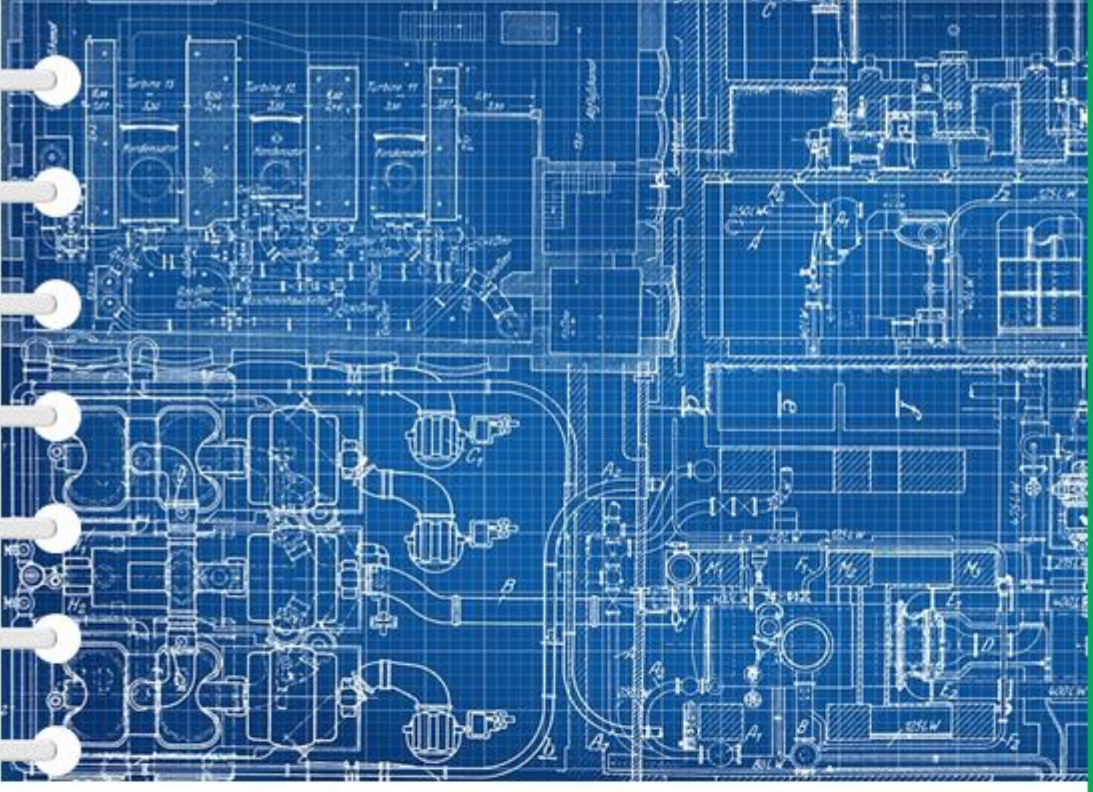

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A Sneak Peek into

Electrical Machines

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Electrical Machines

Electrical machines are the devices that convert electrical energy to mechanical energy or mechanical energy to electrical energy.

Motor

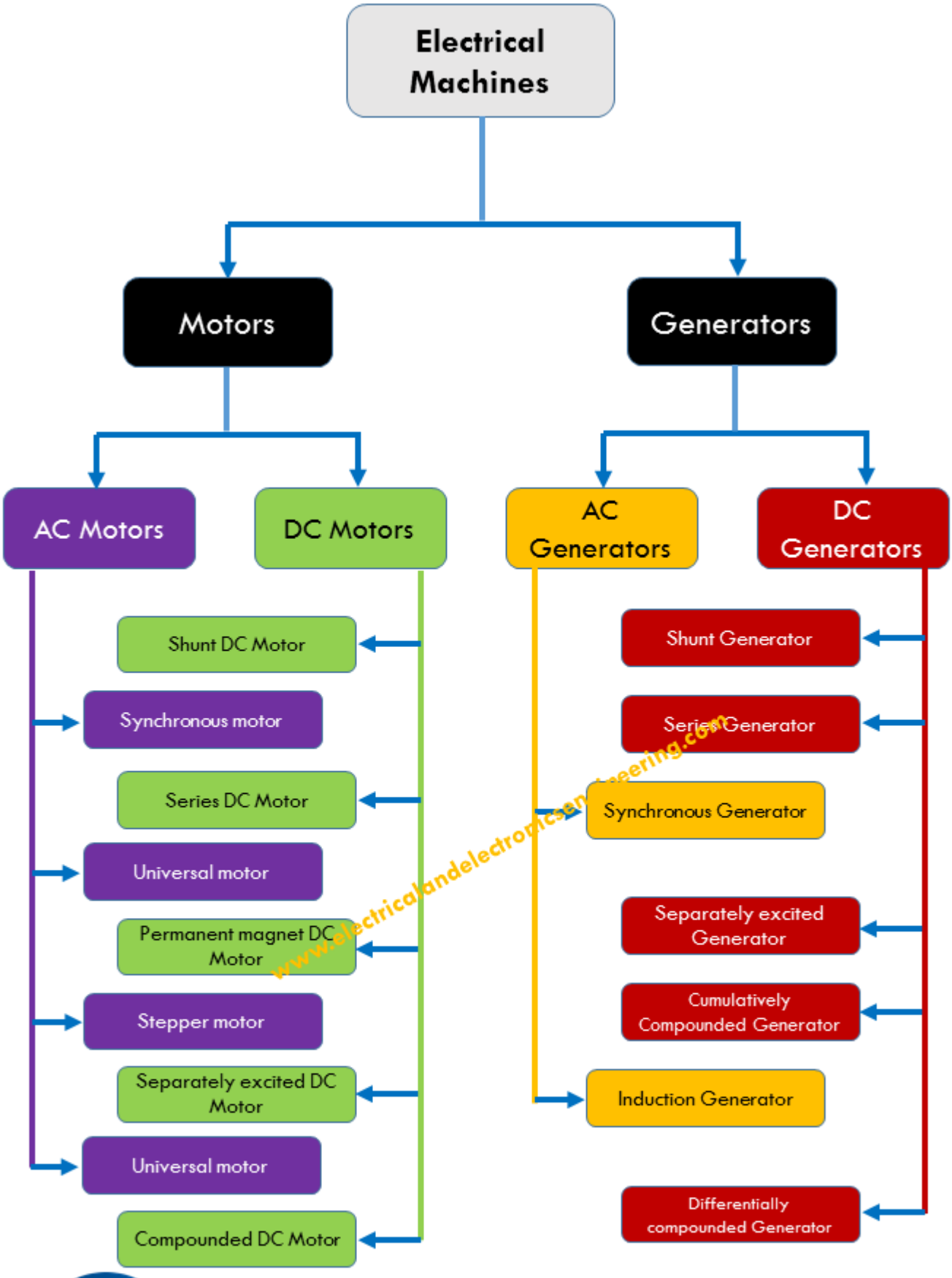
A motor is a machine which converts electrical energy to mechanical energy. Motors are classified into two classes.

1. AC Motors: An AC Motor takes ac power as input and provides mechanical energy at its output
2. DC Motors: A DC Motor has some dc power as its input and it converts dc electricity to mechanical energy

Generator

A generator is a type of machine which converts mechanical energy to electrical energy. Like motors, the generators are also divided into two classes.

1. AC Generator: AC Generator or alternator takes mechanical energy at its input and provides ac electricity at its output
2. DC Generator: DC Generator converts mechanical energy to dc electrical energy (Note that DC Generators are not popular these days and are not employed in modern power systems



Working Principle of Electrical Machines

Motor

A current carrying wire in presence of magnetic field has a force induced on it

Generator

A moving wire in magnetic field has a voltage induced on it.

Induction Motor

Induction motor is one of most popular motors in electrical industry. It is available in two versions:

1. Squirrel cage induction motor
2. Wound rotor induction motor

Both types of motors have same type of rotors, however the construction of rotor gives them their names.

The rotor of squirrel cage induction motor has a rotor which consists of series of bars that are laid into slots carved in face of rotor and are shorted at either end. The wound rotor has set of three phase windings that are identical to stator windings.

An induction motor always operates at a speed lower than the synchronous speed. Additionally induction motor doesn't requires a separate DC field current for excitation purposes.

Synchronous Motor

A synchronous motors gets it name from the synchronous speed. A synchronous motor always turns at synchronous speed.

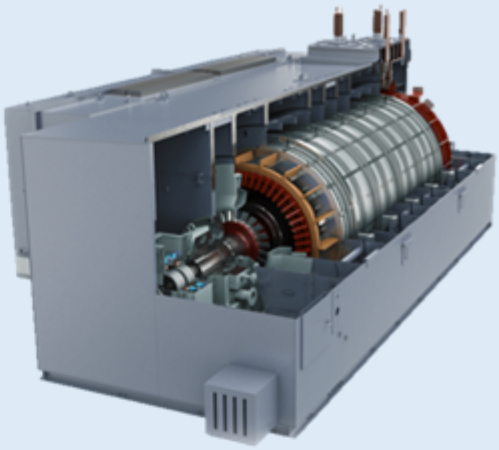
The speed of synchronous motor essentially remains same from no load to full load condition. Unlike an induction motor it requires some type of dc field current for excitation purposes.

A synchronous motor is expensive and complex in construction as compared to the induction motors.

A synchronous motor can operate at either leading or lagging power factor. It can either consume or supply reactive power depending on the operating power factor conditions.

Practicall induction motor is used when we need to run pumps and air compressors at essentially constant speed.

Synchronous Generator



A synchronous generator is a synchronous machine used for converting mechanical power to ac electrical power. Synchronous generator is also known as alternator.

Like all machines the alternator has two windings:

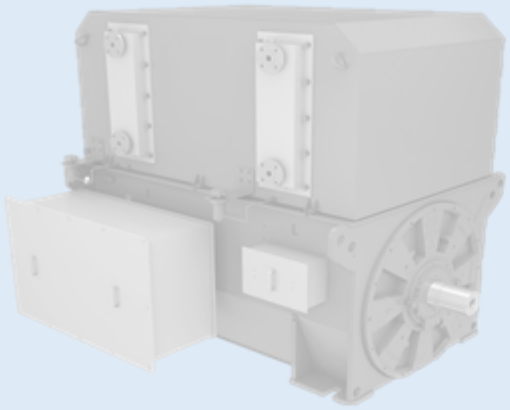
1. Field windings or rotor windings
2. Armature windings or stator windings

In Alternator, the dc current is supplied to the field wingin which produces rotors magnetic field. A prime mover is used to rotate the generator which produces rotating magnetic field in machine.

The rotating magnetic field then induces a three phase set of voltage in armature winding of generator.

This is how a synchronous generator is used for production of electricity. Working of Alternator can be summarized as:

Mechanical Energy → Electrical Energy



Induction Generator

An induction generator consume reactive power as well as its voltage largely varies with changes in load. Induction generators are used in a few limited applications and are not popular in large power system.

Universal Motor

A universal motor is a popular motor used in vacuum cleaners, drill machines, kitchen appliances such as blender and juicer machines, and portable tools.

A universal motor is essentially a series dc motor whose field poles and stator frame is laminated. The pole and stator is laminated so as too deal with core losses which would be very high incase of non-laminated.

Universal machine however runs from ac power supply.

A universal motor possesses sharply dropping torque-speed characteristics and hence is not suitable for constant speed applications. However in terms of torque per ampere, the motor is far better than any other single phase motor.

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