

# A study on electric machines engineering essay



**ASSIGN  
BUSTER**

The classical set of machines represents the asynchronous induction, synchronous, DC machines, and variable reluctance machines. Among these classical machines, the asynchronous machine is most widely used in a large range of applications and is able to operate as a motor (converting electrical power into mechanical power) or as a generator (converting mechanical power into electrical power). The machine can be fed via a power electronic converter or connected directly to an AC or DC supply. Electric machines are majorly based on 4 principles. The first principle is that an electrical current produce a magnetic field around it that can be strengthened by more than a thousand times when passing through iron.

The second principle is called motor action and is defined by a force perpendicular to both the direction of the electrical current and the magnetic field. This induced force is given by:

$$F = i (L)$$

B: magnetic flux density

L= length of wire

i= magnitude of current in the wire

The third principle is that an electrical conductor moving in a magnetic field has an electrical current induced in it creating an electromotive force. The induced voltage is expressed by the following formula:

? ind= (v) L

v: velocity of the wire

L: length of conductor in the magnetic field

B: magnetic flux density

The fourth principle is that a change in the magnetic field in a circuit can cause an induced voltage to this circuit. This effect is based on the Faraday's law that states that when a flux passes through a turn of coil, a voltage proportional to the rate of change of the flux will be induced.

? ind =

N: number of turns of wire in coils

? ind: voltage induced

F: flux passing in the coil

*(<http://mysite.du.edu/~jcalvert/tech/elmotors.htm>)*

An electric machine has two essential electrical parts: The stator and the rotor. The stator (derived from the word stationary) is the stationary part of the machine forming a hollow cylinder consisting of individual electro-magnets shaped towards the middle. The rotor (derived from the word

<https://assignbuster.com/a-study-on-electric-machines-engineering-essay/>

rotating) is located inside the stator and consists of a group of electro-magnet arranged around a cylinder, mounted on the motor's shaft with its poles facing toward the stator poles. The rotor is the rotating component of the machine.

*(<http://www.reliance.com/mtr/mtrthrmn.htm>)*

*(<http://www.reliance.com/mtr/mtrthrmn.htm>)*

In general, when the change of flux is associated with mechanical motion, it is the case of electromagnetic energy conversion. Regarding the rotation machines, the voltage is generated in groups of coils, often called windings, by three different ways. The first technique is by mechanical rotation of the windings through a magnetic field, the second is mechanical rotation of the magnetic field past the winding, and third by the design of the magnetic circuit so that the reluctance varies with the rotation of the rotor. So these methods generate a time-varying voltage caused by the cyclic change of the flux linking a specific coil. The armature winding of a machine is a combination of such coils interconnected so that their generated voltage is close to the desired. In a DC machine, the armature is the rotating member or rotor. As for the AC machine, the armature is the stationary member or stator.

The coils pointed out previously are wound on iron cores in order to maximize the coupling between the coils, to increase the magnetic energy density associated with electromechanical interaction, and to shape and

distribute the magnetic fields according to the requirements of each particular machine design. Eddy currents will be induced in the armature iron since it is subjected to a time varying magnetic flux. To minimize this eddy-current loss, thin laminations for the armature of AC machines construct the armature iron. The magnetic circuit is completed through the iron of the other machine member, and excitation coils, or field windings, may be placed on that member to act as the primary source of flux. Permanent magnets may be used in small machines, and developments in permanent magnet technology are resulting in their use in larger machines. In variable reluctance machines, there are no windings on the rotor, and the operation depends on the non uniformity of air-gap reluctance associated with variations in rotor position.

**(electric machinery fifth edition (LIBRARY))**

### **AC electric machines**

AC machines are motors converting AC electrical energy to mechanical energy and generators that convert mechanical to AC electrical energy. AC electric machines are divided into two types: Asynchronous (induction) and synchronous machines. The difference between these two types is that induction machines have their field currents supplied by magnetic induction while the field current in synchronous ones are supplied by a separate DC source.

**(Electric machinery fundamentals).**

The principle of rotating magnetic fields is the main rule of the operation to most ac motors. The magnetic field created by the poles will make the rotor

<https://assignbuster.com/a-study-on-electric-machines-engineering-essay/>

rotate making the stator poles progressively change. This change will make the rotor follow and rotate with the magnetic field of the stator. As each change is made, the poles of the rotor are attracted by the opposite poles on the stator, forcing the rotor to rotate with the stator field.

*(<http://www.reliance.com/mtr/mtrthrmn.htm>)*

The rotor is rotating within the stator at angular velocity  $\omega$ , the magnitude of the flux density vector  $B$  at any angle  $\alpha$  around the stator is given by  $B = B_m \cos(\omega t - \alpha)$ . Then the voltage induced in the stator that has  $N$  turns of wire is expressed by  $e_{ind} = N \omega B_m \sin(\omega t)$ .

The voltage induced is sinusoidal with amplitude depending on the flux, angular velocity and a constant depending on the construction of the machine.

In a three phase set of coils, the voltages induced will have same magnitude but they are shifted by 120 degrees.

$$e_{aa'}(t) = N \omega B_m \sin(\omega t)$$

$$e_{bb'}(t) = N \omega B_m \sin(\omega t - 120^\circ)$$

$$e_{cc'}(t) = N \omega B_m \sin(\omega t - 240^\circ)$$

The rms voltage of each phase is:  $E_A = \frac{1}{\sqrt{2}} N \omega B_m$