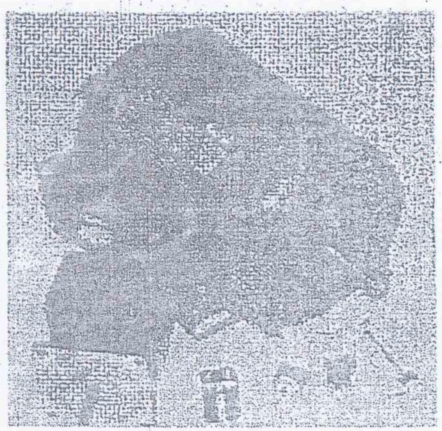
# Unit 8

*Section one : Reading comprehension*

## Electric motor



An electric motor converts electrical energy into mechanical energy. The reverse process, that of converting mechanical energy into electrical energy, is accomplished by a generator or dynamo. Traction motors used on locomotives often perform both tasks if the locomotive is equipped with dynamic brakes. Electric motors are found in household appliances such as fans, refrigerators, washing machines, pool pumps, floor vacuums, and fan-forced ovens.



Most electric motors work by electromagnetism, but motors based on other electromechanical phenomena, such as electrostatic forces and the piezoelectric effect, also exist. The fundamental principle upon which electromagnetic motors are based is that there is a mechanical force on any current-carrying wire contained within a magnetic field. The force is described by the Lorentz force law and is perpendicular to both the wire and the magnetic field. Most magnetic motors are rotary, but linear motors also exist. In a rotary motor, the rotating part (usually on the inside) is called the rotor, and the stationary part is called the stator. The rotor rotates because the wires and magnetic field are arranged so that a torque is developed about the rotor's axis. The motor contains electromagnets that are wound on a frame. Though this frame is often called the armature, that term is often erroneously applied. Correctly, the armature is that part of the motor across which the input voltage is supplied. Depending upon the design of the machine, either the rotor or the stator can serve as the armature.

### Universal motors

A variant of the wound field DC motor is the universal motor. The name derives from the fact that it may use AC or DC supply current, although in practice they are nearly always used with AC supplies. The principle is that in a wound field DC motor the current in both the field and the armature (and hence the resultant magnetic fields) will alternate (reverse polarity) at the same time, and hence the mechanical force generated is always in the same direction. In practice, the motor must be specially designed to cope with the AC current (impedance must be taken into account, as must the pulsating force), and the resultant motor is generally less efficient than an equivalent pure DC motor.

Operating at normal power line frequencies, the maximum output of universal motors is limited and motors exceeding one kilowatt are rare. But universal motors also form the basis of the traditional railway traction motor in electric railways.

In this application, to keep their electrical efficiency high, they were operated from very low frequency AC supplies, with 25 Hz and $16\frac{2}{3}$ hertz operation being common. Because they are universal motors, locomotives using this design were also commonly capable of operating from a third rail powered by DC.

The advantage of the universal motor is that AC supplies may be used on motors which have the typical characteristics of DC motors, specifically high starting torque and very compact design if high running speeds are used. The negative aspect is the maintenance and short life problems caused by the commutator. As a result such motors are usually used in AC devices such as food mixers and power tools which are used only intermittently. Continuous speed control of a universal motor : running on AC is very easily accomplished using a thyristor circuit, while stepped speed control can be accomplished using multiple taps on the field coil. Household blenders that advertise many speeds frequently combine a field coil with several taps and a diode that can be inserted in series with the motor (causing the motor to run on half-wave rectified AC).

Universal motors can rotate at relatively high revolutions per minute (rpm). This makes them useful for appliances such as blenders, vacuum cleaners, and hair dryers where high-speed operation is desired. Many vacuum cleaner and



weed trimmer motors exceed 10,000 rpm, Dremel and other similar miniature grinders will often exceed 30,000 rpm. Motor damage may occur due to overspeed (rpm in excess of design specifications) if the unit is operated with no significant load. On larger motors, sudden loss of load is to be avoided, and the possibility of such an occurrence is incorporated into the motor's protection and control schemes. Often, a small fan blade attached to the armature acts as an artificial load to limit the motor speed to a safe value, as well as provide cooling airflow to the armature and field windings.

With the very low cost of semiconductor rectifiers, some applications that would have previously used a universal motor now use a pure DC motor, sometimes with a permanent magnet field.

## *Comprehension Exercises*

**A. Answer the following questions orally .**

1) What does an electric motor do ?

2) Name some of the household appliances in which electric motor is used ?

3) Explain the fundamental principle upon which electromagnetic motors are based ?

4) Why does the rotor rotates ?

5) What does the armature wrongly and vulgarly means ?

**B . Put "T" for true and " F " for false statements.**

...... 1) Converting mechanical energy into electrical energy is accomplished by a generator or dynamo .

...... 2) All electric motors are rotary .

...... 3) The rotating part of motor is called the rotor and the stationary part is called the stator.

...... 4) The name of universal motors derives from the fact That they may use AC or DC supply current .

...... 5) Universal motors are less efficient than equivalent Pure DC motor .

**C . Multiple choice questions**

1) The device that converts mechanical energy into electriv energy is called ..............

   a) generator b) motor c) dynamo d) a and c

2) ................ Are usually used in locomotives .

   a) Traction motors b) Induction motors

   c) linear motors d) all of them

3) The rotary part of motor is called ..........

   a) rotor b) stator c) armature d) dynamo

4) Universal motors in fact use .............. supply current .

   a) only AC b) only DC c) DC and AC d) often DC

5) RPM in universal motors is .................

   a) relatively high b) relatively low

   c) average d) very low



**D : Fill in the blanks with the following words.**

Electromagnetism tristor circuit rpm

starting torque universal motor piezoelectric

1) Motor damage may occur if ............... is more than design specifications .
2) To control the speed of universal motors a ............. can be used .
3) In DC motors ........................ is very high .
4) Most electric motors work based on ...............
5) In .................. very low frequency supply is usually used to enhance output.

## *Section Two : Traslation Activities*

**A: Translate the following passage into Persian .**

### History and development

The principle of conversion of electrical energy into mechanical energy by electromagnetic means was demonstrated by the British scientist Michael Faraday in 1821 and consisted of a free-hanging wire dipping into a pool of mercury. A permanent magnet was placed in the middle of the pool of mercury. When a current was passed through the wire, the wire rotated around the magnet, showing that the current gave rise to a circular magnetic field around the wire. This motor is often demonstrated in