Frequency of A.C. (Alternating Current) Mains

Direct current and alternating current

An electric current having same (constant) magnitude and same direction, is called steady direct current (D.C.).
An electric current having changing magnitude and changing direction periodically, is called alternating current (A.C.).
A current having changing magnitude (but not becoming zero) and same direction, is called fluctuating current.
A current having magnitude changing between maximum and zero and same direction, is called unidirectional current.

Production of alternating current

A.C. is produced by a dynamo called alternator. In a dynamo a coil rotates in a magnetic field. The coil mounted on a shaft, is rotated by a fast flowing water stream (as in hydro-electric dynamo) or by high pressure steam produced by boiling water by heat of burning charcoal (as in thermo-electric dynamo).
One rotation of coil produces one cycle of alternating current, if the dynamo has only one pair of magnetic poles. Actual dynamo has 16 pairs (alternately north and south) of magnetic poles. Thus one rotation of coil produces 16 cycles of alternating current.
The alternating current supplied to us in our houses, has a frequency of 50 cycles per second (c /s) or 50 hertz (Hz) (hertz means cycles per second).

Root mean square value of A.C.

It is that value of steady current which, when passed through a given resistor for certain time (time for one complete cycle), shall produce the same quantity of heat as the given alternating current shall produce when passed through same resistor for same time.
It is also called virtual value or effective value. It is represented by the symbol $I_{r.m.s.}$ Alternating current and alternating voltage are measured by 'Hot Wire Instrument'. - Hot wire instruments measure the r.m.s. values.

For an alternating current having maximum (peak) value I_0,

$$I_{r.m.s.} = \frac{1}{\sqrt{2}} I_0 = 0.707\, I_0$$

For an alternating voltage having maximum (peak) value E_0, then its r.m.s. value is

$$E_{r.m.s.} = \frac{E_0}{\sqrt{2}} = 0.707\, E_0$$

D.C. Repels—AC. attracts

(a) D.C. Repels. Main line carrying D.C. has same polarity (positive or negative) through¬out. On touching it, the body of the person acquires same polarity as that of the main line. The person touching the line is repelled. D.C. flows in the interior of wire. Hence, thin wire is sufficient to pass D.C.

(b) A.C. attracts. Main line carrying A.C. has quickly changing polarity. On touching it, the polarity of the body of the person also changes. Due to time lag, the body polarity, remains opposite to that of the main line. The person touching the line is attracted. A.C. has the skin effect. It flows over the surface of wire. Hence, thick wire (or many thin wires) is required to A.C. Large surface of wire(s) provide(s) small resistance.

AC. is more dangerous than D.C.

A.C. is more dangerous than D.C. due to following two reasons.

1. A.C. attracts while D.C. repels
2. A.C. gives a huge and sudden shock which becomes fatal.

Merits (advantages) of AC. over D.C

A.C. has following merits (advantages) over D.C.:

1. A.O. can be produced and transmitted easily and cheaply than D.C.
2. A 3-phase A.C. Dynamo can produce more energy than a single phase D.C. Dynamo of same cost.
3. A.C. Dynamo (using slip rings) has less loss of energy and wear and tear than a D.C. Dynamo (using split ring commutator).
4. A.C. voltage can be transformed to any desired value with the help of a transformer.
5. Transmission of A.C. at ‘high-voltage’ and low-current’ reduces line losses.
6. A.C. motors or other A.C. appliances are robust and easier to operate.
7. A.C. can easily be converted into D.C. when required.
8. In A.C. circuits, current can be controlled by a choke coil without much loss of energy.

Demerits (disadvantages) of A.C. over D.C.

A.C. has following demerits (disadvantages) over D.C.:

1. A.G. attracts a person who touches its line where as D.C. gives a repelling shock.
2. A.C. gives a huge and sudden shock which becomes fatal.
3. A.C. is conducted over the surface of a conductor (skin effect). It increases effective resistance of the conductor.
4. Commercial generators do not produce pure A.C.
5. In certain applications like electroplating, battery charging etc. only D.C. is required.

Skin effect

It is found that in an alternating current, the tendency of the moving electrons is to drift towards the surface of the conductor while moving along its axis. This tendency increases with the frequency of A.C. In very high frequency A.C., electrons flow only on the surface of the conductor. This phenomenon (flow of electron on the surface of the conductor), is called skin effect.