Electric Current.

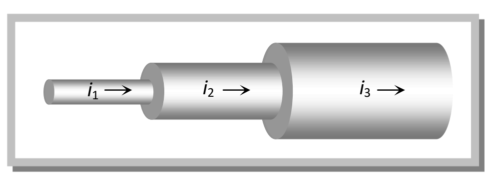
(1) Definition: The time rate of flow of charge through any cross-section is called current. So if through a cross-section, ΔQ charge passes in time Δt then $i_{av} = \frac{\Delta Q}{\Delta t}$ and instantaneous current $i = \lim_{\Delta t \to 0} \frac{\Delta Q}{\Delta t} = \frac{dQ}{dt}$. If flow is uniform then $i = \frac{Q}{t}$. Current is a scalar quantity. Its S.I. unit is ampere (A) and C.G.S. unit is emu and is called biot (Bi), or ab ampere. 1A = (1/10) Bi (ab amp.)

(2) The direction of current: The conventional direction of current is taken to be the direction of flow of positive charge, i.e. field and is opposite to the direction of flow of negative charge as shown below.

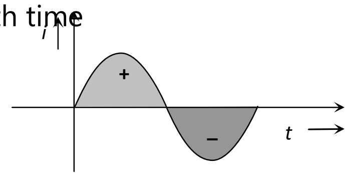
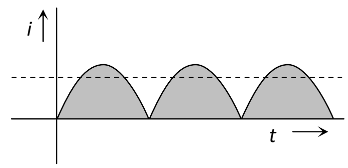
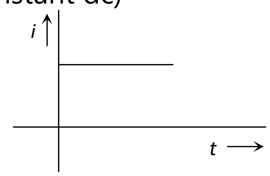
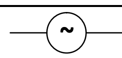
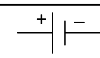
Though conventionally a direction is associated with current (Opposite to the motion of electron), it is not a vector. It is because the current can be added algebraically. Only scalar quantities can be added algebraically not the vector quantities.

(3) Charge on a current carrying conductor: In conductor the current is caused by electron (free electron). The no. of electron (negative charge) and proton (positive charge) in a conductor is same. Hence the net charge in a current carrying conductor is zero.

(4) Current through a conductor of non-uniform cross-section: For a given conductor current does not change with change in cross-sectional area. In the following figure i1 = i2 = i3



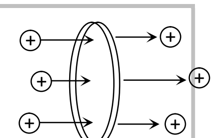
(5) Types of current: Electric current is of two type:

Alternating current (ac)	Direct current (dc)
(i) Magnitude and direction both varies with time  ac → Rectifier → dc (ii) Shows heating effect only	(i) (Pulsating dc) (Constant dc)   dc → Inverter → ac (ii) Shows heating effect, chemical effect and magnetic effect of current
(iii) It's symbol is 	(iii) It's symbol is 

Note: In our houses ac is supplied at 220V, 50Hz.

(6) Current in difference situation:

(i) Due to translatory motion of charge



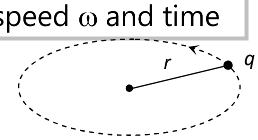
In n particle each having a charge q, pass through a given area in time t then $i = \frac{nq}{t}$

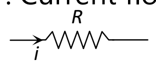
If n particles each having a charge q pass per second per unit area, the current associated with cross-sectional area A is $i = nqA$

If there are n particle per unit volume each having a charge q and moving with velocity v, the current thorough, cross section A is $i = nqvA$

(ii) Due to rotatory motion of charge

If a point charge q is moving in a circle of radius r with speed v (frequency ν, angular speed ω and time



period T) then corresponding currents $i = q\nu = \frac{q}{T} = \frac{qv}{2\pi r} = \frac{q\omega}{2\pi}$
(iii) When a voltage V applied across a resistance R : Current flows through the conductor $i = \frac{V}{R}$ also by definition of power $i = \frac{P}{V}$ 

(7) Current carriers: The charged particles whose flow in a definite direction constitutes the electric current are called current carriers. In different situation current carriers are different.

(I) Solids: In solid conductors like metals current carriers are free electrons.

(ii) Liquids: In liquids current carriers are positive and negative ions.

(iii) Gases: In gases current carriers are positive ions and free electrons.

(iv) Semiconductor: In semiconductors current carriers are holes and free electrons.