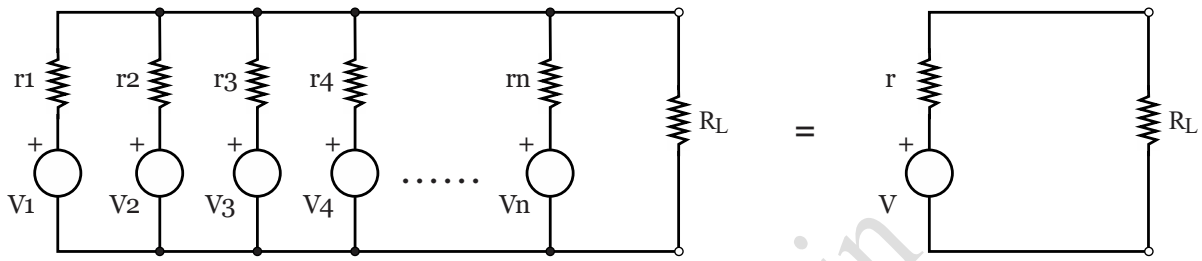
## Millman's theorem

**Statement:** It states that when a number of voltage sources $V_1$, $V_2$, $V_3$… are connected in parallel having their internal resistances as ($r_1$, $r_2$, $r_3$ …) respectively, then this arrangement can be replaced by a single equivalent voltage source (V) in series with an equivalent series resistance (r).

In other words, it determines the voltage across the parallel branches of the circuit which has more than one voltage sources. Thus this theorem reduces the complexity of the circuit, as shown in the following circuit diagram.




As per the statement of this theorem, we can have –

$$V = \frac{V_1.G_1 + V_2.G_2 + V_3.G_3 + V_4.G_4 + \cdots + V_n.G_n}{G_1 + G_2 + G_3 + G_4 + \cdots + G_n}$$

*Where, G is called the conductance of the voltage source.* This equation can also be written as follows –

$$V = \frac{\frac{V_1}{R_1} + \frac{V_2}{R_2} + \frac{V_3}{R_3} + \frac{V_4}{R_4} + \cdots + \frac{V_n}{R_n}}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4} + \cdots + \frac{1}{R_n}}$$

*Where,* $\left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4} + \cdots + \frac{1}{R_n}\right)$ *are the conductances of voltage sources.*