http://www.mbstudent.com/electrical-engineering.html

## Application of branch current method to solve AC circuit.

In this example branch current method will be used to solve electric AC circuit. Example AC circuit is specific because it is a model of one phase from electric AC three phase motor. Number of nodes we mark as $n$, number of equations for Kirchhoff's current law is equal to $(n-1)$.

$$KCL \rightarrow (n-1)$$

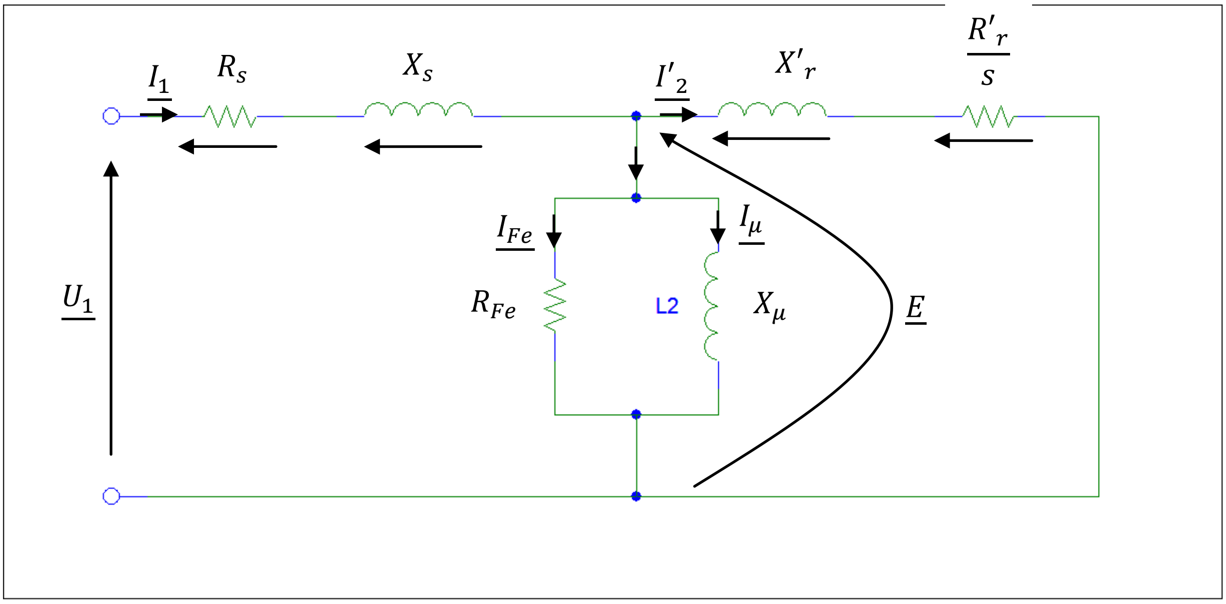
Number of Kirchhoff's voltage law equations depends from number branches and nodes in circuit. General formula for number of Kirchhoff's voltage law equations is given by formula:

$$KVL \rightarrow m-(n-1)$$

$where:$

$m - number\ of\ branches$

$n - number\ of\ nodes$




**Drawing 1. Calculation model of one phase of three phase AC motor.**

$where:$

$\underline{U_1} \rightarrow supply\ voltage's\ vector\ of\ AC\ motor's\ one\ phase$

$\underline{I_1} \rightarrow\ current\ of\ one\ stator's\ one\ phase$

$R_s \rightarrow stator's\ resistance$

$X_s \rightarrow\ stator's\ inductive\ reactance$

$\underline{I'_2} \rightarrow current\ of\ one\ rotor's\ phase\ which\ is\ brought\ to\ stator$

$X'_r \rightarrow inductive\ reactance\ rotor's\ phase\ which\ is\ brought\ to\ stator$

$\frac{R'_r}{s} \rightarrow resistance\ of\ rotor's\ phase\ divided\ by\ slip\ which\ is\ brought\ to\ stator$

$s = \frac{n_0 - n}{n_0} \rightarrow rotor's\ slip$

$\underline{E} \rightarrow electromotorical\ force$
$\underline{I_{Fe}} \rightarrow current\ which\ represents\ losts\ in\ iron$
$R_{Fe} \rightarrow resistance\ of\ iron$
$\underline{I_{\mu}} \rightarrow magnetizing\ current$
$X_{\mu} \rightarrow magnetizing\ inductive\ reactance$

Kirchhoff's current law $(KCL)$ equation for circuit:

$$\underline{I_1} - \underline{I'_2} - \underline{I_{Fe}} - \underline{I_{\mu}} = 0$$

Kirchhoff's voltage law $(KVL)$ equation for first mesh:

$$\underline{U_1} - R_s \cdot \underline{I_1} - j \cdot X_s \cdot \underline{I_1} - \underline{E} = 0$$

Kirchhoff's voltage law $(KVL)$ equation for second mesh:

$$\underline{E} - j \cdot X'_r \cdot \underline{I'_2} - \frac{R'_r}{s} \cdot \underline{I'_2} = 0$$

Note also that

$$\underline{E} = R_{Fe} \cdot \underline{I_{Fe}} = j \cdot X_{\mu} \cdot \underline{I_{\mu}}$$