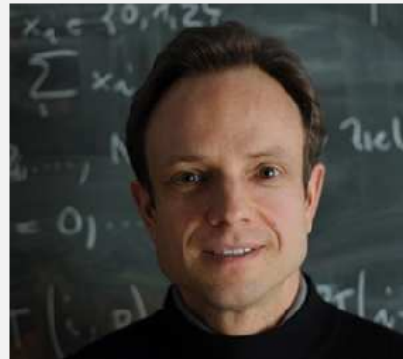




Nodal potentials $M_k \in \mathbb{C}$, $k=1, \dots, n$
 $\hookrightarrow$ Unknowns

②

Circuit element $\rightarrow$ branch current-voltage relationship

[branch voltage : $M_k - M_j$]

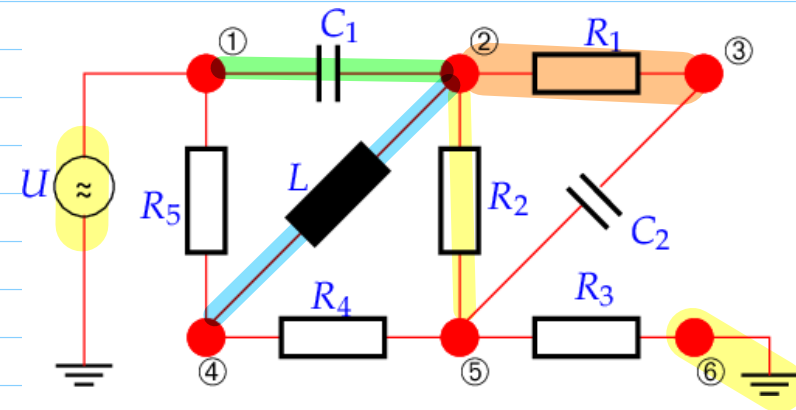
- Ohmic resistor: $I = \frac{U}{R}$, $[R] = 1VA^{-1}$
- capacitor: $I = i\omega CU$, capacitance $[C] = 1AsV^{-1}$
- coil/inductor: $I = \frac{U}{i\omega L}$, inductance $[L] = 1VsA^{-1}$

$$I_{kj} = \begin{cases} R^{-1}(U_k - U_j), \\ i\omega C(U_k - U_j), \\ -i\omega^{-1}L^{-1}(U_k - U_j). \end{cases}$$

branch current $\uparrow$
branch voltage $\downarrow$

$$I = \sum \alpha M, \alpha \in \mathbb{C}$$

with KCL: $\sum_{j=1}^n \alpha_{kj} (M_k - M_j) = 0 ; k=1, \dots, n$
 $\stackrel{!}{=} \text{LSE}$



Voltage source

$\rightarrow M_1$ known

$$M_6 = 0$$

$\Rightarrow$ Can drop the KCL eqn. for $k=7,6$

$$\begin{aligned} \textcircled{2}: & i\omega C_1(U_2 - U_1) + R_1^{-1}(U_2 - U_3) - i\omega^{-1}L^{-1}(U_2 - U_4) + R_2^{-1}(U_2 - U_5) = 0, \\ \textcircled{3}: & R_1^{-1}(U_3 - U_2) + i\omega C_2(U_3 - U_5) = 0, \\ \textcircled{4}: & R_5^{-1}(U_4 - U_1) - i\omega^{-1}L^{-1}(U_4 - U_2) + R_4^{-1}(U_4 - U_5) = 0, \\ \textcircled{5}: & R_2^{-1}(U_5 - U_2) + i\omega C_2(U_5 - U_3) + R_4^{-1}(U_5 - U_4) + R_3^{-1}(U_5 - U_6) = 0, \\ & U_1 = U, \quad U_6 = 0. \end{aligned}$$

$\uparrow$ known $\rightarrow$ r.h.s vector

$$\begin{pmatrix} i\omega C_1 + \frac{1}{R_1} - \frac{i}{\omega L} + \frac{1}{R_2} & -\frac{1}{R_1} & \frac{i}{\omega L} & -\frac{1}{R_2} \\ -\frac{1}{R_1} & \frac{1}{R_1} + i\omega C_2 & 0 & -i\omega C_2 \\ \frac{i}{\omega L} & 0 & \frac{1}{R_5} - \frac{i}{\omega L} + \frac{1}{R_4} & -\frac{1}{R_4} \\ -\frac{1}{R_2} & -i\omega C_2 & -\frac{1}{R_4} & \frac{1}{R_2} + i\omega C_2 + \frac{1}{R_4} + R_3^{-1} \end{pmatrix} \begin{pmatrix} U_2 \\ U_3 \\ U_4 \\ U_5 \end{pmatrix} = \begin{pmatrix} i\omega C_1 U \\ 0 \\ \frac{1}{R_5} U \\ 0 \end{pmatrix}$$

③

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