Transient Analysis II

Dr. Mohamed Refky Amin
Electronics and Electrical Communications Engineering Department (EECE)
Cairo University
elc.n112.eng@gmail.com
http://scholar.cu.edu.eg/refky/

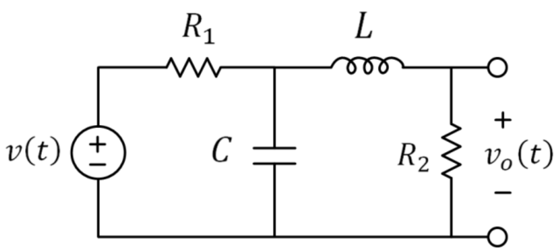
OUTLINE

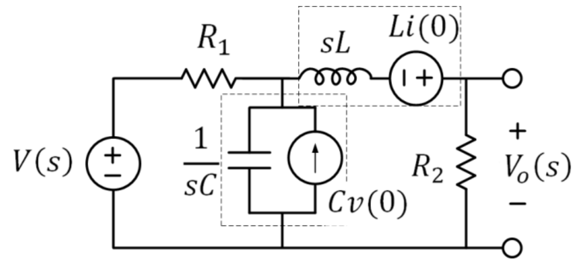
- Application of the Laplace
  - Use of s-Domain Circuit Models
- Analysis Techniques
  - Superposition
  - Thévenin and Norton Equivalent Circuit
  - Loop and Node Analysis

Applications of the Laplace

Steps in Applying the Laplace Transform

1) Transform the circuit from the time domain to the s-domain.



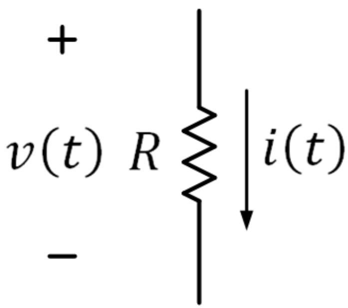


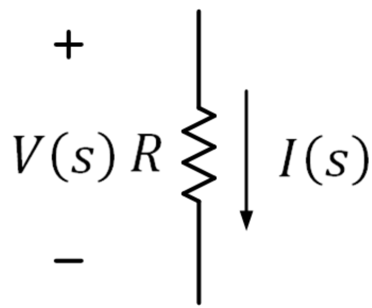
2) Solve the circuit using nodal analysis, mesh analysis, source transformation, superposition, or any circuit analysis technique with which we are familiar.

3) Take the inverse transform of the solution and thus obtain the solution in the time domain.

Circuit Element Models

Resistor Model



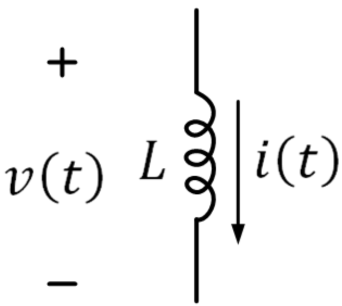


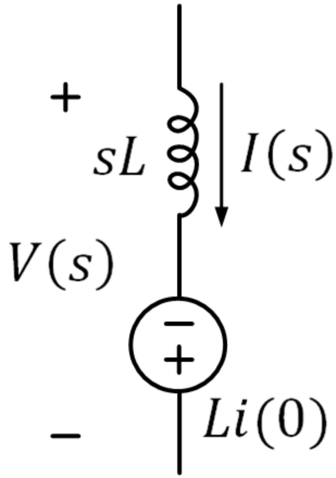
$$v(t) = R \times i(t)$$

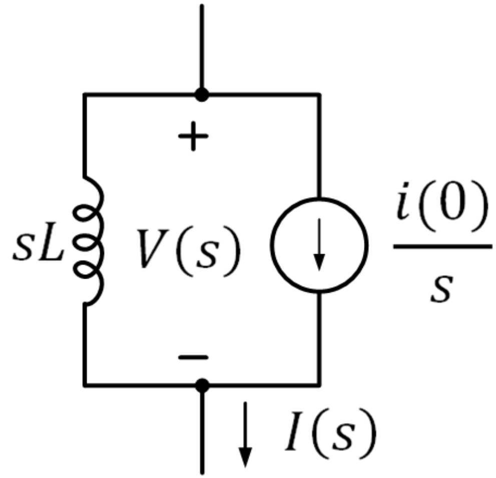
$$V(s) = R \times I(S)$$

Circuit Element Models

Inductor Model







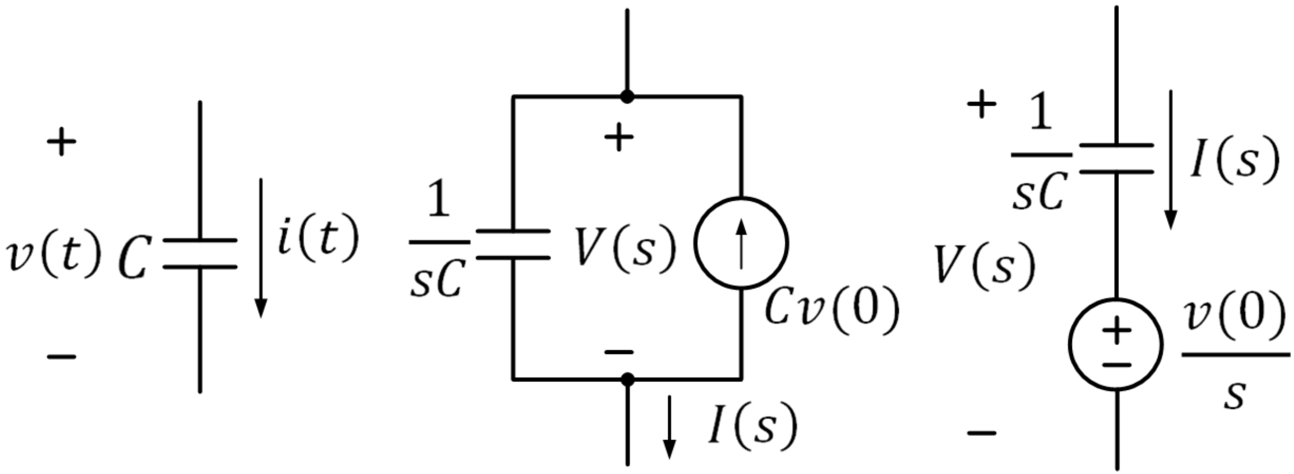
$$v(t) = L\frac{d}{dt}i(t)$$

$$I(s) = \frac{V(s)}{sL} + \frac{i(0)}{s}$$

$$\begin{aligned} V(s) &= L(sI(S) - i(0)) \\ &= sLI(s) - Li(0) \end{aligned}$$

Circuit Element Models

Capacitor Model



$$i(t) = C\frac{d}{dt}v(t)$$

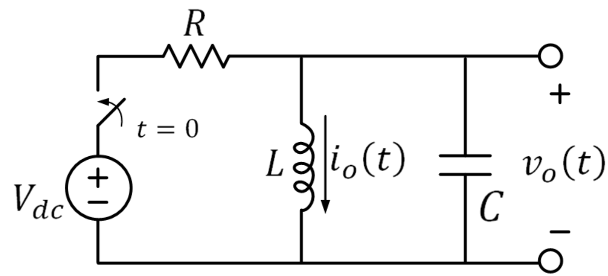
$$V(s) = \frac{I(s)}{sC} + \frac{v(0)}{s}$$

$$\begin{aligned} I(s) &= C(sV(S) - v(0)) \\ &= sCV(s) - Cv(0) \end{aligned}$$

Applications of the Laplace

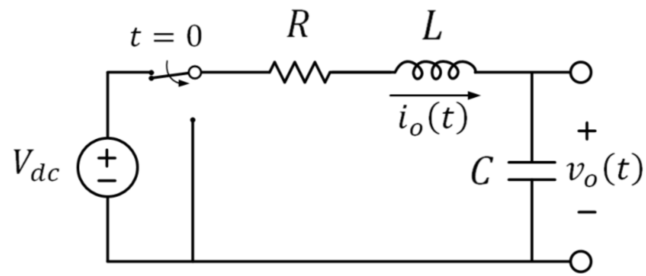
Example (1)

- Assume zero initial condition $i_L(0) = 0$ and $v_C(0) = 0$



Applications of the Laplace

Example (2)



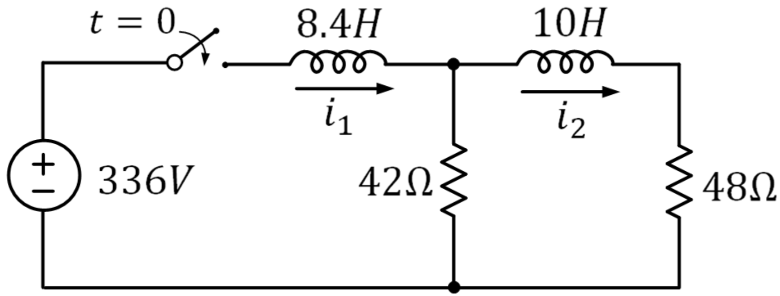
Applications of the Laplace

Analysis Techniques

- Loop and Node Analysis
- Superposition
- Thévenin and Norton Equivalent Circuit

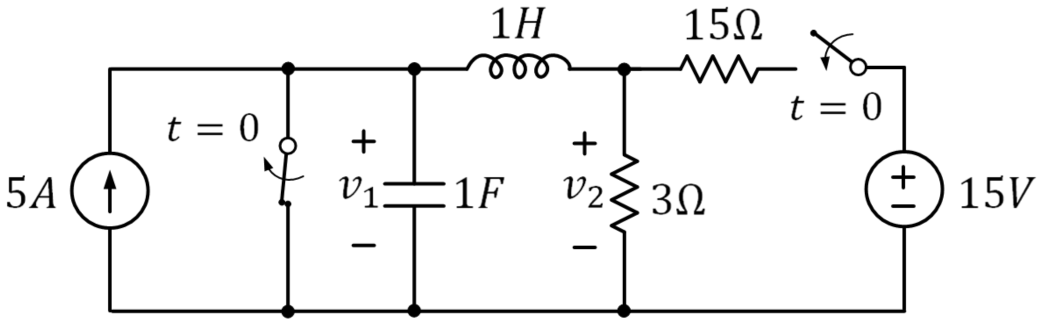
Applications of the Laplace

Example (3): Loop Analysis



Applications of the Laplace

Example (3): Superposition



Applications of the Laplace

Example (4): Thévenin Equivalent