Fall 2019

微分方程
Differential Equations

Unit 04.1
Models of Engineering Problems

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NTU-EE

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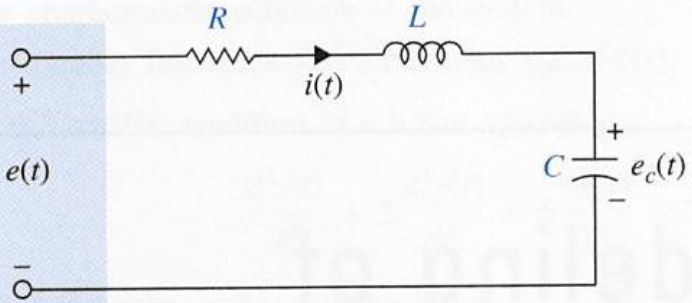
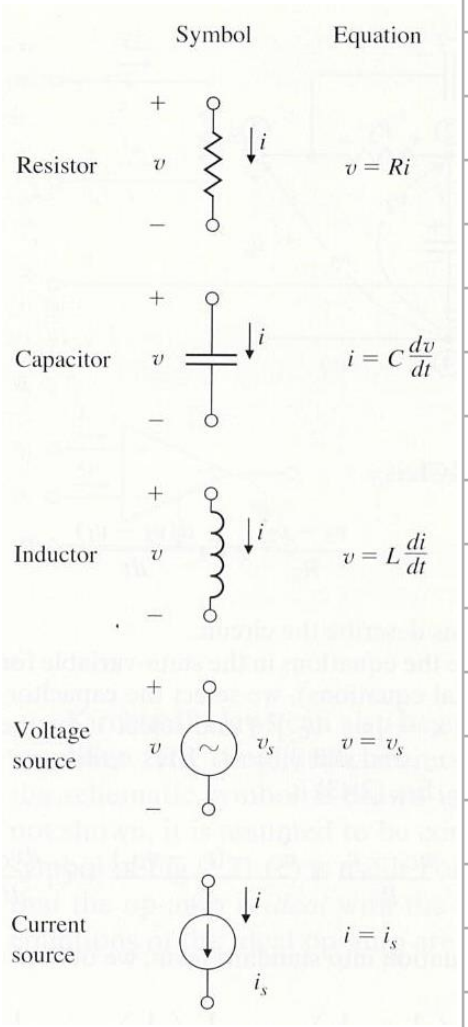
Figures and images used in these lecture notes are adopted from
Differential Equations with Boundary-Value Problems, 9th Ed., D.G. Zill, 2018 (Metric Version)

Model of Electrical Circuits

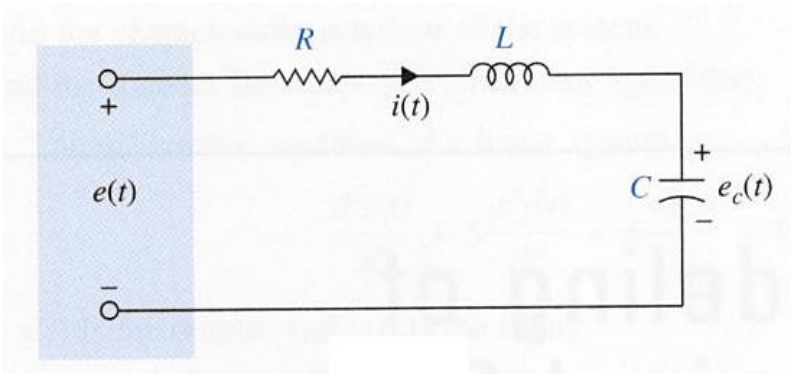


Current in C: $$C\frac{de_c(t)}{dt} = i(t)$$

Voltage in L: $$L\frac{di(t)}{dt} = -e_c(t) - Ri(t) + e(t)$$



Model of Electrical Circuits



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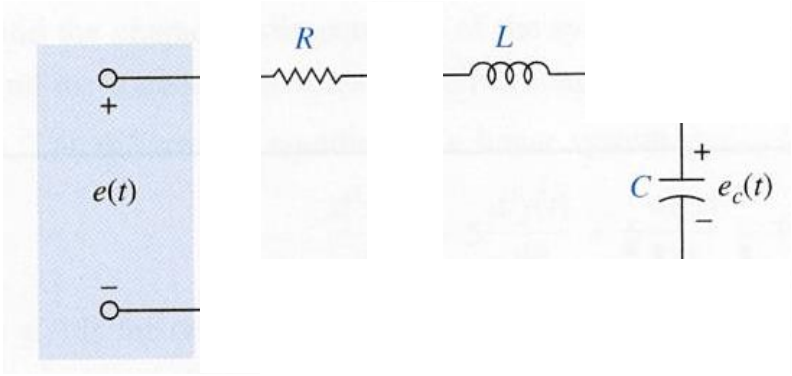
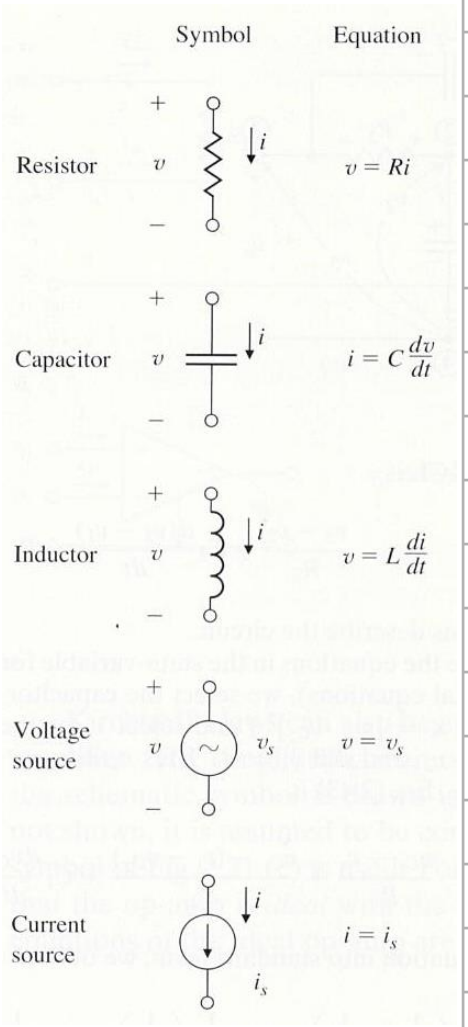
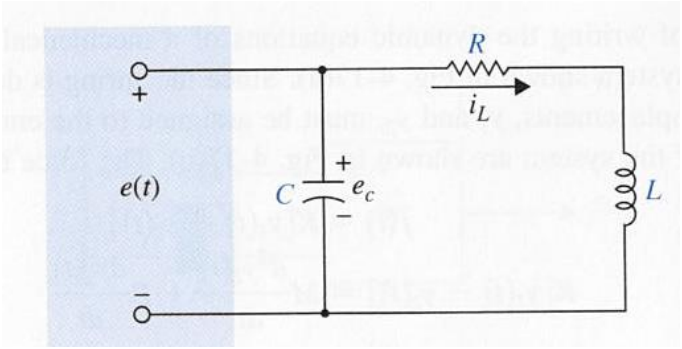


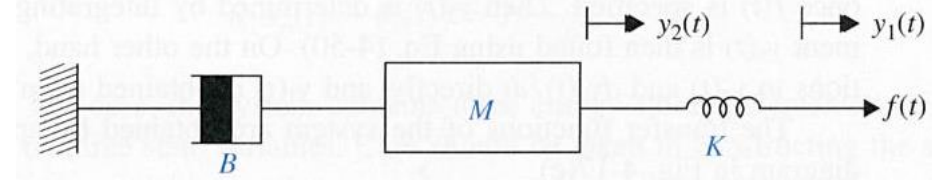


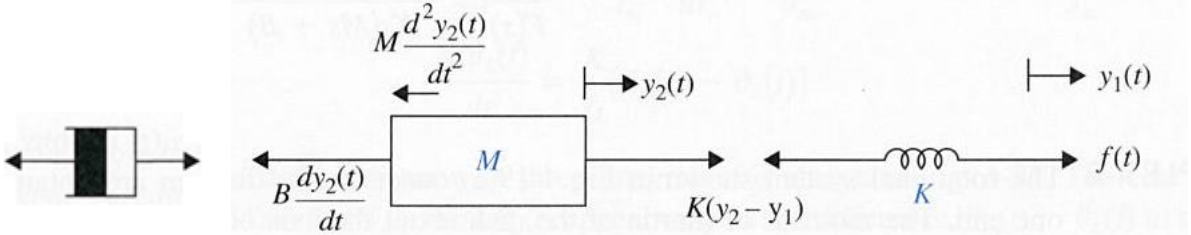
Model of Electrical Circuits



	Symbol	Equation
Resistor	+ v − , i	$v = Ri$
Capacitor	+ v − , i	$i = C\frac{dv}{dt}$
Inductor	+ v − , i	$v = L\frac{di}{dt}$
Voltage source	+ v − , v_s	$v = v_s$
Current source	i , i_s	$i = i_s$

Model of Mass-Spring-Friction System





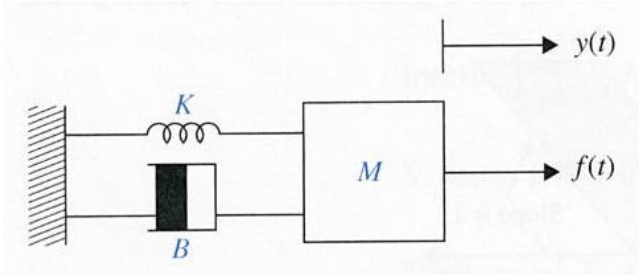
$$f(t) = K[y_1(t) - y_2(t)]$$

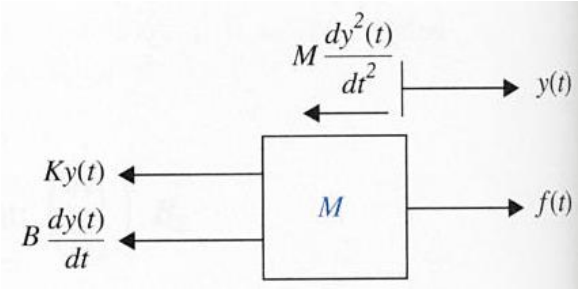
$$K[y_1(t) - y_2(t)] = M\frac{d^2y_2(t)}{dt^2} + B\frac{dy_2(t)}{dt}$$

$$y_1(t) = y_2(t) + \frac{1}{K}f(t)$$

$$\frac{d^2y_2(t)}{dt^2} = -\frac{B}{M}\frac{dy_2(t)}{dt} + \frac{K}{M}[y_1(t) - y_2(t)]$$

Model of Mass-Spring-Friction System





Equations and Their Solution Sets

- $x + 5 = 0$
- $x^2 + 3x - 4 = 0$
- $x^2 + 3x + 4 = 0$
- $x^3 + 2x^2 + x - 4 = 0$