

Fall 2019

微分方程
Differential Equations

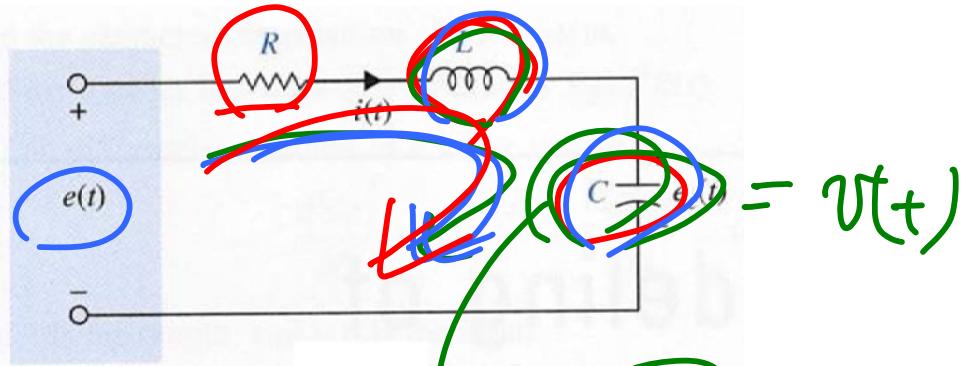
Unit 04.1
Models of Engineering Problems

Feng-Li Lian

NTU-EE

Sep19 – Jan20





Current in C :

Voltage in L :

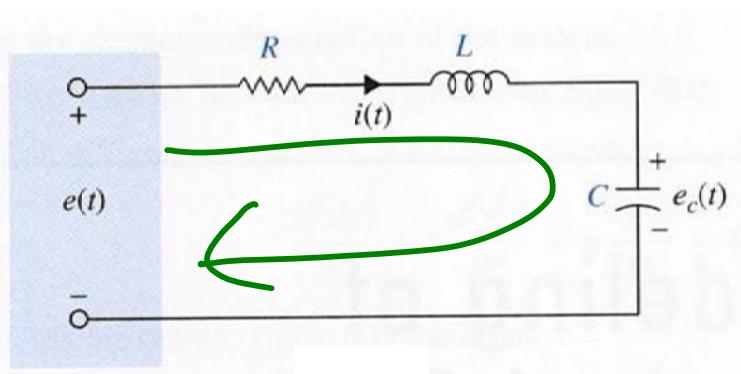
$$L \frac{di(t)}{dt} = -e_c(t) - Ri(t) + e(t)$$

$$L \frac{d^2i}{dt^2} = -R \frac{di}{dt} + e(t)$$

$$a_2 \frac{d^2y}{dx^2} + a_1 \frac{dy}{dx} + a_0 y = g(x)$$

$$y(x) = \dots \quad y' = \dots \quad i(t)$$

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

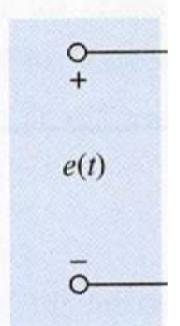


Current in C :

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

Voltage in L :

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



$$\dot{U}_1 \sim \sqrt{3}$$

$$R$$

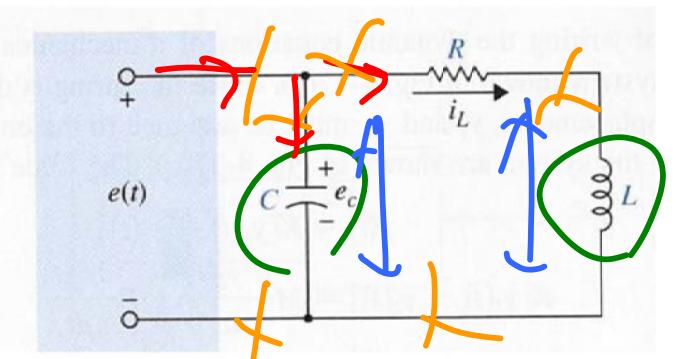
$$e(t)$$

$$C \frac{de_c(t)}{dt} \sim \sqrt{2}$$

$$L$$

$$i_3$$

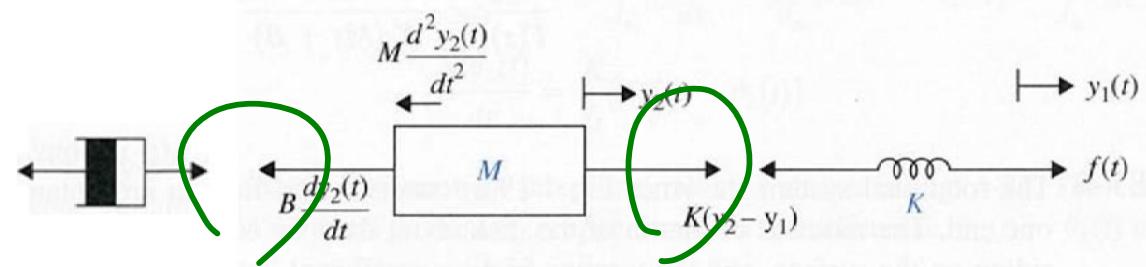
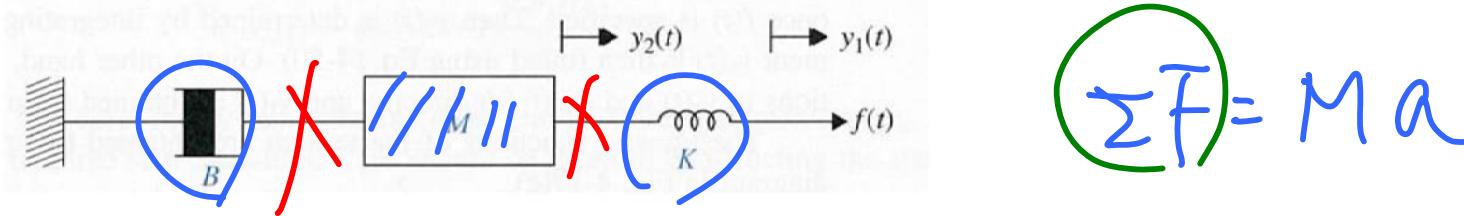
	Symbol	Equation
Resistor		$v = Ri$
Capacitor		$i = C \frac{dv}{dt}$
Inductor		$v = L \frac{di}{dt}$
Voltage source		$v = v_s$
Current source		$i = i_s$



$$a_2 \frac{d^2y}{dx^2} + a_1 \frac{dy}{dx} + a_0 y = g(x)$$

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

Model of Mass-Spring-Friction System



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

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

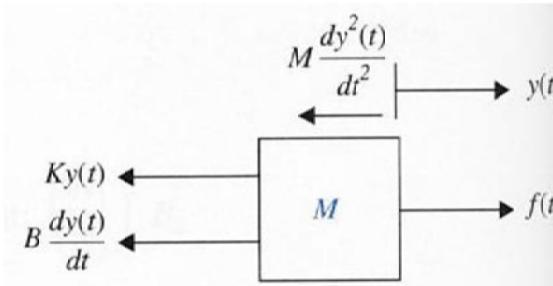
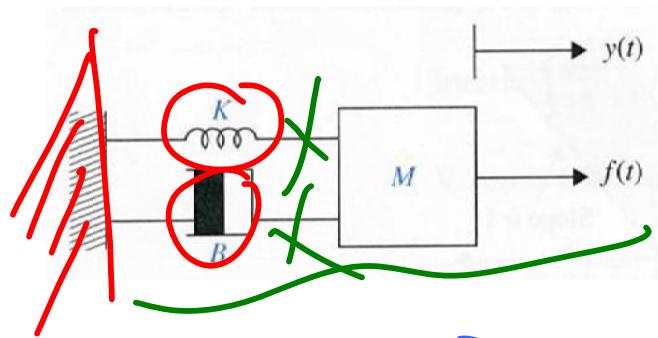
$$y_1(t) = y_2(t) + \frac{1}{K}f(t)$$

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

\Rightarrow

$$a_2 \cancel{\frac{dy}{dx}} + c_1 \cancel{\frac{dy}{dx}} + a_0 y = g(x)$$

Model of Mass-Spring-Friction System



$$a_2 \frac{d^2y}{dx^2} + a_1 \frac{dy}{dx} + a_0 y = g(x)$$

$$\bullet x + 5 = 0 \Rightarrow x = -5 \quad x \in \mathbb{R}$$

$$\bullet \frac{x^2 + 3x - 4}{(x+4)(x-1)} = 0 \Rightarrow x = -4, x = 1 \quad x \in \mathbb{R}$$

$$\bullet \frac{x^2 + 3x + 4}{2} = \frac{-3 \pm \sqrt{15}i}{2} \quad x \in \mathbb{C}$$

$$\bullet \frac{x^3 + 2x^2 + x - 4}{(x-1)(x^2+3x+4)} = 0$$