TI DSP, MCU 및 Xilinx Zynq FPGA 프로그래밍 전문가 과정

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목차

회로이론

6) capacitor

○ Capacitor

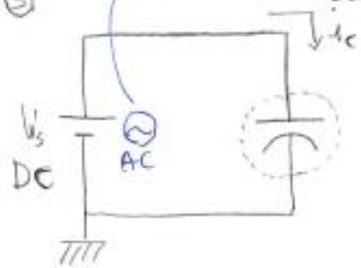
① 세라믹 전해

② $i_c = C\frac{dV}{dt} \Rightarrow \frac{1}{C}\int_0^t i_c\,dt = \int_0^t dV$

$= V(t) - V(0)$

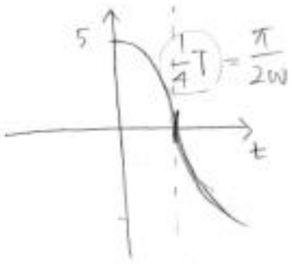
③ $5\cos(\omega t) \Rightarrow \omega = 2\pi f$

$f = \frac{\omega}{2\pi} \Rightarrow \frac{1}{T} \therefore T = \frac{2\pi}{\omega}$



• $i_c = C\frac{dV}{dt}$

전압의 변화량이 없을 때 까지



• 전류의 원천

전위 (전기적 위치에너지)

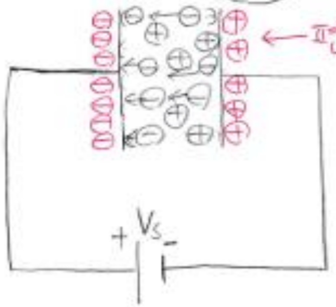
전압이 같으면?

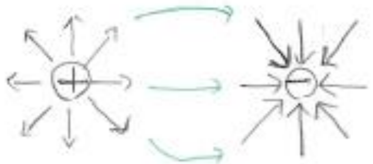
전위차 X

↳ 전류 X

④ ← 전기장 ⇒ 에너지 저장됨

←편극 (전자기학) 현상





⑤ 전력

$p = VI = I^2R = \frac{V^2}{R} \rightarrow CV\frac{dV}{dt}$

에너지 (일)

$W = p\cdot t \rightarrow W = \int p\,dt$

$W = \int CV\,dV$

$\therefore W = \frac{1}{2}CV^2$

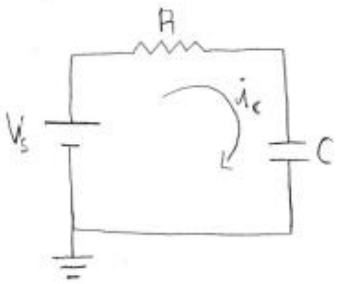
* 콘덴서 직렬, 병렬 연결

• 직렬: 저항의 병렬처럼

• 병렬: 저항의 직렬처럼

7) capacitor 회로 해석

o 회로에서 Capacitor 해석 (충전)



1) $Q = CV \qquad V_c = \frac{Q}{C}$

2) $V_s = i_c R + V_c$

$= \frac{dq}{dt} R + \frac{q}{C}$

3) $V_s = Rq' + \frac{1}{C} q$

$q' + \frac{1}{RC} q = \frac{V_s}{R}$

적분인자 $\mu = e^{\frac{t}{RC}}$

4) $\underbrace{q'}_{D}\,\underbrace{e^{\frac{t}{RC}}}_{ND} + \underbrace{q}_{ND}\,\underbrace{\frac{1}{RC} e^{\frac{t}{RC}}}_{D} = \frac{V_s}{R} e^{\frac{t}{RC}}$

$\int \frac{d}{dt}\left(q e^{\frac{t}{RC}}\right) = \int \frac{V_s}{R} e^{\frac{t}{RC}}$

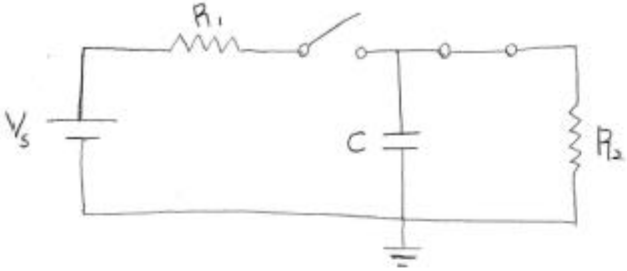
$q e^{\frac{t}{RC}} = \frac{V_s}{R} RC e^{\frac{t}{RC}} + D$

$\therefore q = CV_s + D e^{-\frac{t}{RC}}$, $q(0) = 0$ ($\because D = -CV_s$)

$= CV_s\left(1 - e^{-\frac{t}{RC}}\right)$

5) $V_c = V_s\left(1 - e^{-\frac{t}{RC}}\right) \Rightarrow t = \infty$, $V_c = V_s$ (전압 공급원)

o 회로에서 Capacitor 해석 (자연응답)



1) $q(0) = CV_s$ (완충) , $Q = CV \Rightarrow V = \frac{Q}{C}$

$i = \frac{dq}{dt}$

2) $0 = \frac{1}{C}\int i_c\, dt + i_c R_2$

$= \frac{1}{C} q + R_2 q'$

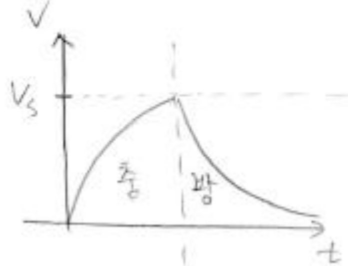
3) $q e^{\frac{t}{RC}} = D$

$q = D \cdot e^{-\frac{t}{RC}}$

$= CV_s e^{-\frac{t}{RC}}$

$\therefore V_c = V_s e^{-\frac{t}{RC}}$

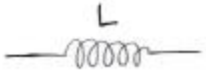
방전식



8~9) inductor , 회로 해석

○ Inductor

* 직렬, 병렬 모두 저항과 동일



① $V_L = L\frac{di}{dt}$

자기 회로

→ 전류의 변화가 급작스럽게 바뀌면 ($\frac{di}{dt}$ ↑) 역기전력이 발생함.

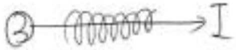
② $W = \int p\,dt$

$p = VI$

$W = \int LI\frac{di}{dt}\,dt$

$= \frac{1}{2}Li^2$

자기장

③ 

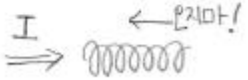
오른 나사 법칙

(자기장 방향)

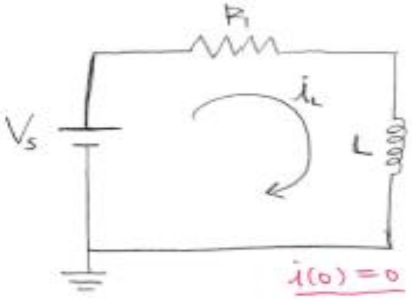
④ 역학 관성

전기 역기전력

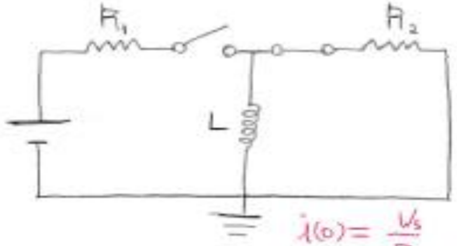
현재의 상태를 유지하고자 함.



○ 회로에서 Inductor 해석 (충전) ⟷ 방전



$i(0) = 0$



$i(0) = \frac{V_s}{R_1}$

(완.충)

1) $V_s = i_L R + L\frac{di}{dt}$

$= Li' + Ri$

2) $i' + \frac{R}{L}i = \frac{V_s}{L}$, $\mu = e^{\frac{R}{L}t}$

$\underbrace{i'}_{D}\underbrace{e^{\frac{R}{L}t}}_{ND} + \underbrace{\frac{R}{L}e^{\frac{R}{L}t}}_{D}\underbrace{i}_{ND} = \frac{V_s}{L}\cdot e^{\frac{R}{L}t}$

3) $\int\frac{d}{dt}(ie^{\frac{R}{L}t}) = \int\frac{V_s}{L}e^{\frac{R}{L}t}$

$ie^{\frac{R}{L}t} = \frac{V_s}{L}\cdot\frac{L}{R}e^{\frac{R}{L}t} + C$

$\therefore\ i = \frac{V_s}{R} + Ce^{-\frac{R}{L}t}$

$= \frac{V_s}{R}(1 - e^{-\frac{R}{L}t})$

4) $V = L\frac{di}{dt} = \frac{\cancel{R}}{L}\cdot\frac{V_s}{\cancel{R}}e^{-\frac{R}{L}t}$

1) $0 = L\frac{di}{dt} + iR_2$

$= Li' + R_2 i$

$= i' + \frac{R_2}{L}i$

2) $\int\frac{d}{dt}(ie^{\frac{R_2}{L}t}) = \int 0$

$ie^{\frac{R_2}{L}t} = C$

$i = C\cdot e^{-\frac{R_2}{L}t} = \frac{V_s}{R_1}\cdot e^{-\frac{R_2}{L}t}$

3) $\therefore\ V = -\frac{V_s}{R_1}\cdot\frac{R_2}{L}Le^{-\frac{R_2}{L}t}$

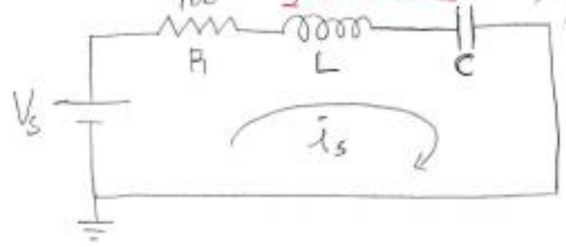
$= -\frac{V_s}{R_1}R_2e^{-\frac{R_2}{L}t}$

10) RLC 회로 해석

ㅇ RLC 회로해석

$\frac{1}{2}Li^2 \overset{에너지}{\longleftrightarrow} \frac{1}{2}CV^2$, $Q=CV$

$V=\frac{Q}{C}$



⇒ 에너지 보존 법칙

$VI + \frac{1}{2}LI^2 + \frac{1}{2}CV^2$ 일정

ㅇ 저항에 걸리는 전압

$i_s(t)R = V_R(t)$

ㅇ 인덕터에 걸리는 전압

$V_L(t) = L\frac{di_s(t)}{dt}$

ㅇ 콘덴서에 걸리는 전압

$V_c(t) = \frac{1}{C}\int i_s(t)\,dt$

1) $V_s = i_s R + L\frac{di_s}{dt} + \frac{1}{C}\int i_s\,dt$

2) 미분 ⇒ $0 = i_s' R + L i_s'' + \frac{1}{C} i_s$

3) $i_s'' + \frac{R}{L} i_s' + \frac{1}{LC} i_s = 0$

4) 이계도 미방 ⇒ 「 $x^2 + \frac{R}{L}x + \frac{1}{LC} = 0$ 」

5) $x = -\frac{b \pm \sqrt{b^2-4ac}}{2a}$

$= -\frac{\frac{R}{L} \pm \sqrt{\frac{R^2}{L^2} - 4\frac{1}{LC}}}{2}$

ㅇ 공진 발생 조건

「 $\frac{R^2}{L^2} - \frac{4}{LC} < 0$ 」

통신 RF

6) $i(t)$

① 서로 다른 두 실근

$C_1 e^{r_1 t} + C_2 e^{r_2 t}$

② 중근

$C_1 e^{rt} + C_2 t e^{rt}$

③ 복소근 $(\lambda + i\mu)$

$C_1 e^{\lambda} \cos(\mu t) + C_2 e^{\lambda} \sin(\mu t)$