TI DSP, MCU, Xilinx Zynq FPGA 기반의 프로그래밍 전문가 과정

<공학 수학>

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공진주파수 안되는 회로

<안테나>

$Q = CV$

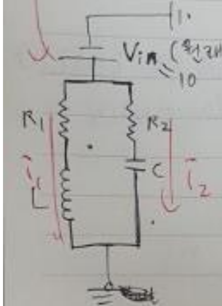
$V_L = L\frac{di}{dt}$

$i_c = C\frac{dv}{dt}$

전기장 미분하면 전압

Date

<5.24>



Vin $= 10$ (원래는 RF 신호가 들어와야 함)

1. $10 = L\frac{di_1}{dt} + iR_1$
2. $10 = -iR_2 - \frac{1}{c}\int_0^t i\,dt$

1. $10 = Li_1' + i_1R_1$
2. $10 = i_2R_2 + \frac{1}{c}\int i_2\,dt$

1. $\frac{10}{s} = I_1(s)R_1 + L\{sI_1(s) - i(0)\} \rightarrow \frac{10}{s} = I_1(s)(R_1 + Ls) - L\cancel{i(0)}$
2. $\frac{10}{s} = I_2(s)R_2 + \frac{I_2(s)}{sc}$

$\frac{10}{s} = I_2(s)\left(R_2 + \frac{1}{sc}\right) \rightarrow 10c = I_2(s)(R_2sc + 1)$

$I_2(s) = \frac{10c}{R_2sc+1}$, $I_1(s) = \frac{10}{(R_1+Ls)s}$

$\boxed{I_1(s) = \frac{10}{Ls^2+R_1s}}$, $I_2(s) = \frac{10}{\frac{1}{c}+R_2s} = \boxed{\frac{10c}{1+R_2sc}}$

$= \frac{10}{L\left(s^2+\frac{R_1s}{L}\right)}$

$\boxed{\mathcal{L}\{\cosh(\omega t)\} = \frac{\omega}{s^2-\omega^2}}$

$I_1(s) = \frac{10}{L\left\{\left(s+\frac{R_1}{2L}\right)^2 - \frac{R_1^2}{4L^2}\right\}}$ $\omega = \frac{R_1}{2L}$

$I_1(s) = \frac{20L}{R_1}\frac{\frac{R_1}{2L}}{\left(s+\frac{R_1}{2L}\right)^2 - \left(\frac{R_1}{2L}\right)^2}\cdot\frac{1}{L}$ $\omega = \frac{R_1}{2L}$, 그 꼴으로 계수는 $\frac{2L}{R_1}\times 10$

$i_L(t) = \frac{20}{R_1}\cosh\left(\frac{R_1}{2L}t\right)e^{-\frac{R_1}{2L}t}$

$V_L(t) = \frac{R_1}{2L}\frac{20}{R_1}\sinh\left(\frac{R_1}{2L}t\right)e^{-\frac{R_1}{2L}t} - \frac{R_1}{2L}\frac{20}{R_1}\cosh\left(\frac{R_1}{2L}t\right)e^{-\frac{R_1}{2L}t}$

$I_2(s) = \frac{10c}{R_2cs+1} = \frac{10c}{R_2c\left(s+\frac{1}{R_2c}\right)} = \frac{10}{R_2}\cdot\frac{1}{\left(s+\frac{1}{R_2c}\right)}$

$\Rightarrow i_2(t) = \frac{10}{R_2}e^{-\frac{t}{R_2c}}$

$V_c(t) = \frac{1}{c}\int i_c(t)\,dt = \frac{1}{c}\frac{10}{R_2}\int_0^t e^{-\frac{t}{R_2c}}\,dt = \frac{10}{R_2c}(-R_2c)\, e^{-\frac{t}{R_2c}}\Big|_0^t$

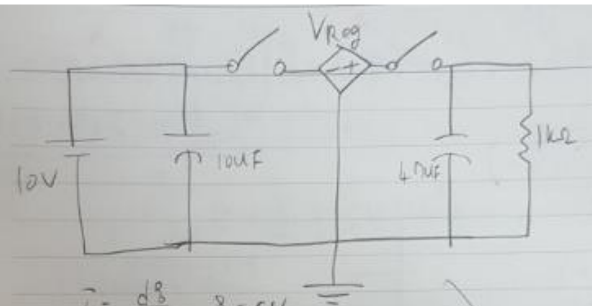
$= -10\left[e^{-\frac{t}{R_2c}}\right]_0^t = -10\left(e^{-\frac{t}{R_2c}} - 1\right) = 10\left(1 - e^{-\frac{t}{R_2c}}\right)$

$\boxed{V_c(t) = 10\left(1 - e^{-\frac{t}{R_2c}}\right)}$

※

$\boxed{10\times10^4\,pF}$

$104 = 10^5\,pF = 10^{-7}\,F = 0.1\,\mu F = 100\,nF$



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

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

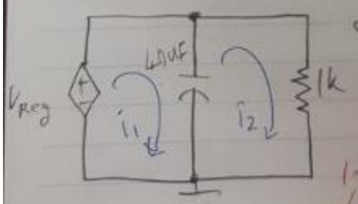
0 ~ 0.000001초

0~1μS 사이에 5V 스위치 off

1~2μS 사이에 4.95V 스위치 on

2~3μS 사이에 5V 스위치 off

3~4μS 사이에 4.95V 스위치 on



1~2us 2~3us 3~4us

$$V_{reg} = 5[H(t)] - 0.05[H(t-10^{-6})] + 0.05[H(t-2\times10^{-6})] - 0.05[H(t-3\times10^{-6})]$$

1. $V_{reg} = \frac{q_1 - q_2}{C} = \frac{q_1 - q_2}{47} 10^6$

2. $i_2 R + \frac{q_2 - q_1}{C} = 0 \Rightarrow q_2' + \frac{q_2 - q_1}{47} 10^3 = 0$

$5[H(t)] - 0.05[H(t-10^{-6})] = \frac{10^6}{47}(q_1 - q_2)$

$$\mathcal{L}\{1\text{번식}\} = \frac{5}{s} - 0.05\frac{1}{s}e^{-10^{-6}s} = \frac{10^6}{47}\left\{Q_1(s) - Q_2(s)\right\}$$

$$\mathcal{L}\{2\text{번식}\} = sQ_2(s) - \cancel{q_2(0)} + \frac{10^3}{47}\left\{Q_2(s) - Q_1(s)\right\}$$

$$\Rightarrow Q_2(s) = \frac{\frac{10^3}{47}}{s + \frac{10^3}{47}}Q_1(s) = \frac{10^3}{47s+10^3}Q_1(s)$$

$$\Rightarrow \frac{5}{s} - 0.05\frac{1}{s}e^{-10^{-6}s} = \frac{10^6}{47}\left\{Q_1(s) - \frac{10^3}{47s+10^3}Q_1(s)\right\}$$

$$= \frac{10^6}{47} \times \frac{47s}{47s+10^3}Q_1(s)$$

$$\frac{5}{s} - 0.05\frac{1}{s}e^{-10^{-6}s} = \frac{10^6 s}{47s+10^3}Q_1(s)$$

$$5 - 0.05e^{-10^{-6}s} = 10^6 \cdot \frac{s^2}{47s+10^3}Q_1(s)$$

$$Q_1(s) = \frac{5-0.05e^{-10^{-6}s}}{10^6\frac{s^2}{47s+10^3}} = \frac{1}{10^6}\frac{47s+10^3}{s^2}\left(5-0.05e^{-10^{-6}s}\right)$$

$$Q_2(s) = \frac{10^6}{47s+10^3}\frac{1}{10^6}\frac{47s+10^3}{s^2}\left(5-0.05e^{-10^{-6}s}\right)$$

$$= \frac{1}{10^3}\frac{1}{s^2}\left(5-0.05e^{-10^{-6}s}\right)$$

내적 : $\langle f, g\rangle = \int_a^b f(x)g(x)dx$ $\quad \|f\| = \sqrt{\langle f, f\rangle} = \sqrt{\int_a^b [f(x)]^2 dx}$

내적이 0 이면 직교한다.

$\langle f(x), g(x)\rangle = \int_a^b f(x)g(x)dx$ ⇒ 두 함수가 서로 직교한다!

$\int_{-\pi}^{\pi} \sin x \cdot \sin 2x \, dx$ $\quad e^{ix} = \cos x + j\sin x$, $\sin x = \frac{e^{ix}-e^{-ix}}{2j}$

$$\int_{-\pi}^{\pi} \frac{e^{ix}-e^{-ix}}{2j}\cdot\frac{e^{2ix}-e^{-2ix}}{2j}dx = -\frac{1}{4}\int(e^{ix}-e^{-ix})(e^{2ix}-e^{-2ix})dx =$$

$$= -\frac{1}{4}\int(e^{3ix}-e^{-ix}-e^{ix}+e^{-3ix})dx$$

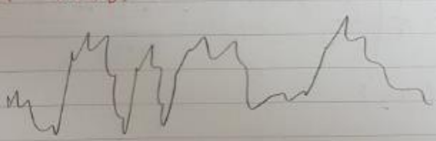
$$= \frac{1}{2}\int_{-\pi}^{\pi}\{\cos x - \cos 3x\}dx = 0$$

$$= \frac{1}{2}\left[\sin x - \frac{1}{3}\sin 3x\right]_{-\pi}^{\pi} = 0 \Rightarrow \text{직교}$$

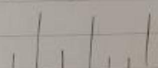
<푸리에 급수>

$f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty}\left(a_n\cos\left(\frac{n\pi}{T}x\right) + b_n\sin\left(\frac{n\pi}{T}x\right)\right)$ — 정의

주기적분의 특성!



⇐ 무슨 신호인지 모름.



← f 축으로 변환(시간정보를 모두 잃어버림)

+ Laplace (z-transform)

* 특정한 시간에 대해 반복된 변환 가능.

\ 이 좋기는 단점: 스텝의도함수 못구함
장점: 미분방정식을 대수방정식으로 변환

$$\int_{-T}^{T} f(x) = \int_{-T}^{T} \frac{a_0}{2} + \int_{-T}^{T} \sum_{n=1}^{\infty} \left\{ a_n \cos\left(\frac{n\pi}{T}x\right) + b_n \sin\left(\frac{n\pi}{T}x\right) \right\}$$

$$= \int_{-T}^{T} \frac{a_0}{2} + \sum_{n=1}^{\infty} \left\{ \int_{-T}^{T} a_n \cancel{\cos\left(\frac{n\pi}{T}x\right)} + b_n \cancel{\sin\left(\frac{n\pi}{T}x\right)} \right\}$$

$$\int_{-T}^{T} f(x) = \int_{-T}^{T} \frac{a_0}{2}$$

$$\boxed{\therefore a_0 = \frac{1}{T}\int_{-T}^{T} f(x)}$$

주기가 같을 때 살아

<cos 계수 구하기>

$$\int_{-T}^{T} f(x) \cos\left(\frac{n\pi}{T}x\right) = \frac{a_0}{2}\cancel{\int_{-T}^{T} \cos\left(\frac{n\pi}{T}x\right)} + \sum_{n=1}^{\infty} \left\{ \int_{-T}^{T} a_n \cos\left(\frac{n\pi}{T}x\right) \cos\left(\frac{n\pi}{T}x\right) \right.$$

$$\left. + \int_{-T}^{T} b_n \cancel{\sin\left(\frac{n\pi}{T}x\right) \cos\left(\frac{n\pi}{T}x\right)} \right\}$$

$$\int_{-T}^{T} f(x) \cos\left(\frac{n\pi}{T}x\right) = \underbrace{\sum_{n=1}^{\infty} \left\{ \int_{-T}^{T} a_n \cos\left(\frac{n\pi}{T}x\right) \cos\left(\frac{n\pi}{T}x\right) \right\}}_{a_n T}$$

$$\cos x = \frac{e^{ix} + e^{-ix}}{2}$$

$$\cos^2 x = \frac{e^{2ix} + 2 + e^{-2ix}}{4} = \frac{1}{2}\left(\frac{e^{2ix} + e^{-2ix}}{2} + 1\right) = \frac{1}{2}\left(\underbrace{\cos 2x}_{\text{주기적분 0}} + 1\right)$$

$$a_n = \frac{1}{T}\int_{-T}^{T} f(x) \cos\left(\frac{n\pi}{T}x\right)$$

<Sin의 계수 구하기>

$$\int_{-T}^{T} f(x)\sin\left(\frac{n\pi}{T}x\right) = \frac{a_0}{2}\cancel{\int_{-T}^{T}\sin\left(\frac{n\pi}{T}x\right)}^{0} + \sum_{n=1}^{\infty}\left\{\cancel{\int_{-T}^{T} a_n\cos\left(\frac{n\pi}{T}x\right)\sin\left(\frac{n\pi}{T}x\right)} + \underbrace{\int_{-T}^{T} b_n\sin\left(\frac{n\pi}{T}x\right)\sin\left(\frac{n\pi}{T}x\right)}_{b_n T}\right\}$$

$$\boxed{b_n = \frac{1}{T}\int_{-T}^{T} f(x)\sin\left(\frac{n\pi}{T}x\right)}$$

$$\boxed{a_0 = \frac{1}{T}\int_{-T}^{T} f(x)}$$

<사각파>

$H(t) - H(t-1)$

$$\begin{cases} 0 & (-\pi < x < 0) \\ 1 & (0 < x < \pi) \end{cases}$$

$$a_0 = \frac{1}{\pi}\int_{-\pi}^{\pi} f(x)\,dx = \frac{1}{\pi}\left(\int_{-\pi}^{0} 0\,dx + \int_{0}^{\pi} (1)\,dx\right) = 1$$

$$a_n = \frac{1}{\pi}\int_{-\pi}^{\pi} f(x)\cos\left(\frac{n\pi}{T}x\right)dx = \frac{1}{\pi}\left(\cancel{\int_{-\pi}^{0} 0\,dx} + \int_{0}^{\pi}\cos\left(\frac{n\pi}{T}x\right)dx\right)$$

$$= \frac{T}{n\pi}\left[\sin\left(\frac{n\pi}{T}x\right)\right]_0^{\pi} = 0$$

$$b_n = \frac{1}{\pi}\int_{-\pi}^{\pi} f(x)\sin\left(\frac{n\pi}{T}x\right)dx$$

$$= \frac{1}{\pi}\left[\int_{-\pi}^{0} 0\,dx + \int_{0}^{\pi}\sin\left(\frac{n\pi}{T}x\right)dx\right] = -\frac{1}{\pi}\left[\frac{T}{n\pi}\cos\left(\frac{n\pi}{T}x\right)\right]_0^{\pi}$$

$$= -\frac{2T}{n\pi^2} = -\frac{2}{n\pi}$$

$$-\frac{1}{\pi}\frac{1}{n}\left[\cos(nx)\right]_0^{\pi}$$

$$= -\frac{1}{n\pi}\left[\cos(n\pi) - 1\right]$$

$$= \frac{1}{n\pi}\left(1 - \cos(n\pi)\right)$$

$$\boxed{\begin{aligned} \therefore f(x) &= \frac{1}{2} + \sum_{n=1}^{\infty}\left\{-\frac{2}{n\pi}\sin\left(\frac{n\pi}{T}x\right)\right\} \\ &= \frac{1}{2} + \sum_{n=1}^{\infty}\left\{\frac{1}{n\pi}\left[1-\cos(n\pi)\right]\sin(nx)\right\} \end{aligned}}$$