EE 360
Final Exam Review

Friday, Dec. 3^{rd}, 2021

Ch. 1: Signals

- Energy
- Power
- ~~Neith~~ Neither Energy or Power

- function: Rule: unique elements

elements $x \rightarrow f(x)$: y

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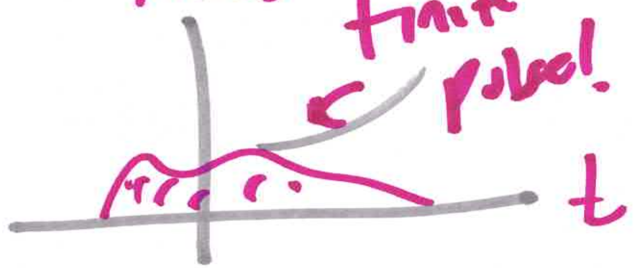
1)



$$E_x = \int_{t=-\infty}^{t=\infty} |x(t)|^2 \, d\tau$$

$$P_x = \lim_{T\to\infty} \frac{1}{T} \int_{t=-\infty}^{t=\infty} |x(t)|^2$$

Periodically!

Doesn't Exist

$X(t) = A e^{at} e^{j\beta t}$

$X(t) = C$

Ch. 2 - Systems

Properties:

- Linearity
- Scaling
- etc.

Block Diagrams

DFI

DFII

~~Less~~ Less Components!

TDFII

Save Components!

- Diff. eqs

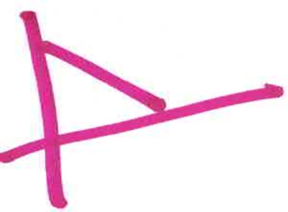
For loops

- SS Eqns

Analog	Digital
Next state $\dot{q}(t)$	Next state $q(n+1)$

Ch: 3 : Convolution

h(t)



Analog

$$y(t) = x(t) * h(t)$$

$$= \int_{\tau=-\infty}^{\tau=\infty} x(\tau)\, h(t-\tau)\, d\tau =$$

Shift

Const.

Stays Still

x(τ)

$h(-\tau)$

Digital

Const

h(k)

x(n)

$$y(n) = h(n) * x(n)$$

$$= \sum_{k=-\infty}^{k=\infty} \underbrace{h(k)}_{Const}\, \underbrace{x(n-k)}_{Shift!\ \&\ flip}$$

Math way!

$$y(0) = h(0)x(0) + h(1)x(-1)$$

$$y(1) = h(0)x(1) + h(1)x(0)$$

Digital

Res Pole

$x(n) = c\alpha^n u(n)$ ← looks like impulse

$h(n) = \beta^n u(n)$

$ay(n) - y(n-1) = x(n)$

Find $h(n)$

Prob. 0. find $h(n)$

$x(n) = h(n)$

1. Solve using Convolution!

Do NOT use Z-T

2. Do it again with Z-T

Compare

Find: $h(n)$

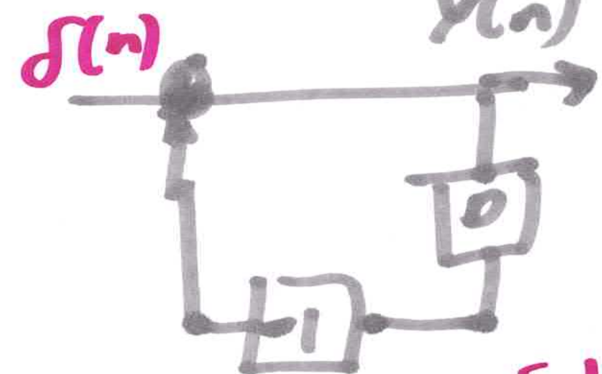
Kick!

Aux Eqn!

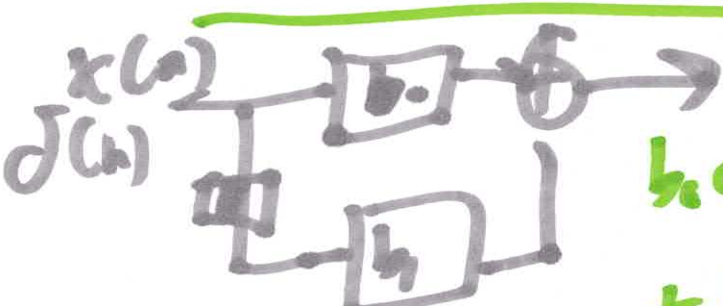
$$y(n) - y(n-1) = 0$$

$C(n)$

build FB Sys!



$$x(n) \pm x(n-1) = 0$$



$$b_0 \delta(n) + b_1 \delta(n-1)$$

FF

$h_{zeros}(n)$

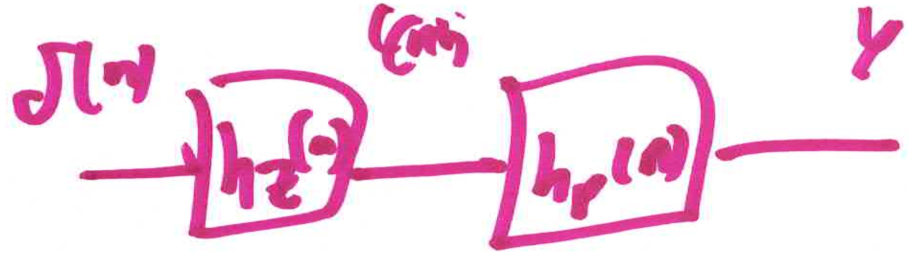
$$\lambda - 1 = 0$$

$$\lambda = 1$$

$$y_{FB}(n) = C_1 (\lambda_1)^n u(n)$$

$$y(0) = 1$$

Solve $h_{poles}(n)$!



$c(n) = \delta(n) * h_z(n)$

$= h_z(n)$

ZIR!

$c(n) = 0 * h_z(n)$

$= 0$

memory!

Pain!

$y(n) = h_z(n) * h_p(n)$

ZSR

Pr. Stubbs rules!

Aux! $y(n) - y(n-1) = 0$

$\lambda - 1 = 0$

$\lambda = 1$

$y_{zsr}(0) = k$

7) $\boxed{y_{Tot} = y_{zsr} + y_{zir}}$

$y_{zir}(n) = C_1(\lambda_1)^n u(n)$ ← EZ

SS Eqn

Analog

$\dot{q}(t) = A\,q(t) + B\,x(t)$

or

L-T

$sQ(s) =$

$Y(s) \rightarrow$ SS Eqn

$h(t)$

Digital

Prob 6 ?

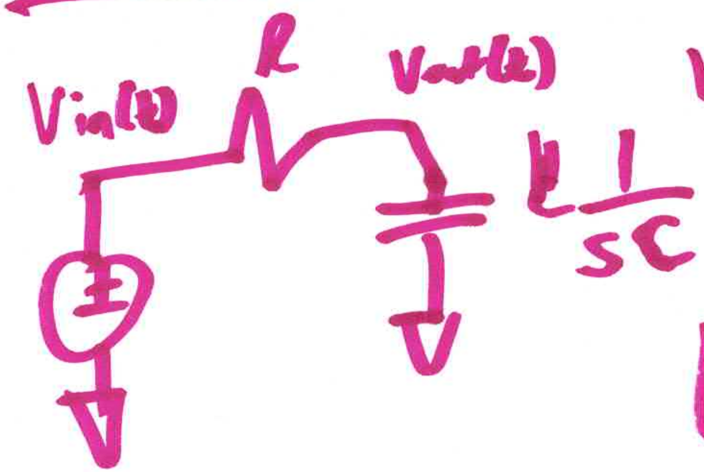
$q(n+1)$

$z\,q(z)$

Prob 7 ?

$Y(z) \xrightarrow{C} [zI - A]^{-1}B + DX(z)$

Steady state



$$V_{out}(s) = \frac{1/sC}{R + 1/sC} = \frac{1}{1+sRC} \rightarrow e^{-\frac{t}{RC}} u(t)$$

$s = j\omega$

$$|V_{out}(s)| = \frac{1}{|1+j\omega RC|} = \frac{1}{\sqrt{1+(\omega RC)^2}}$$

Mag. Response

Eigenfunct-

1KHz

$V_{in}(t) = \sin(\omega_0 t)$

1K

$\measuredangle H = -\tan^{-1}(\omega RC)$

1k

$j \measuredangle H(s=\omega_0)$

$V_{out}(t) = H(s=\omega_0)\, V_{in}(t) \cdot e$

Also equivalent in Z-T

Ch. 5: Laplace

$$L(x(t)) = X(s) = \int_{t=-\infty}^{t=\infty} x(t)e^{-st}\,dt$$

$e^{at}u(t)$

$u(t) \to \frac{1}{s}$

Properties

Unilateral LT

$$\frac{dy(t)}{dt} \to sY(s) - y(0^-)$$

$r(t) \to \frac{1}{s^2}$

$t^2u(t)$

I.C.s!

$y(t=0^-) = K$

$$\frac{1}{s}\cdot\frac{1}{s} \to \frac{A}{s} + \frac{B}{s^2}?$$

2

2 poles

eo!

- Residues
- poles

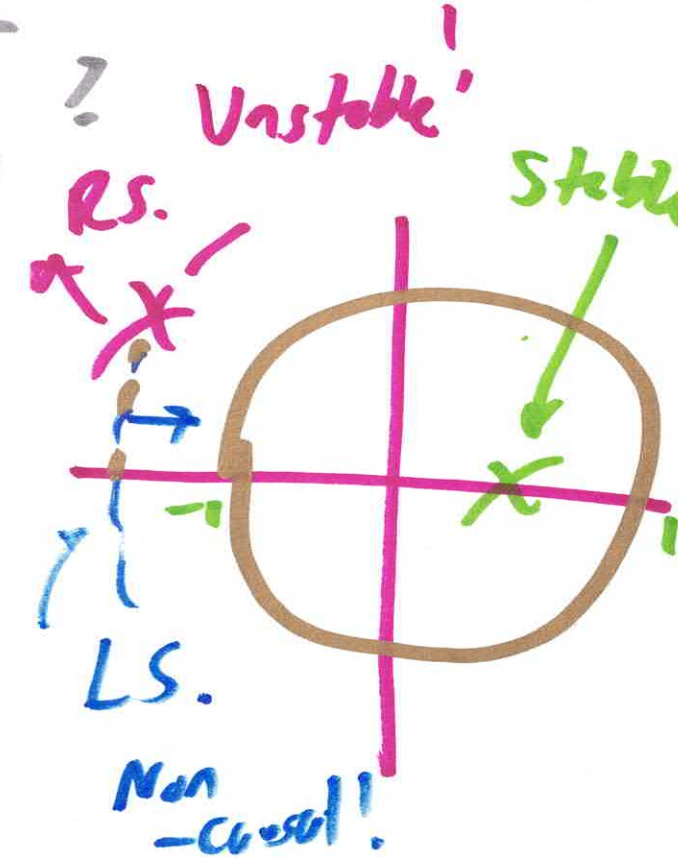
Repeated Roots

Analyze LT props → Res $e^{\text{pole}\,t}u(t)$

Partial fractions

Z-T

$$X(z) = \sum_{n=-\infty}^{n=\infty} x(n) z^{-n}$$



Unilateral

Z-T

$$x(n-1) \rightarrow z^{-1}X(z) + x(-1)$$

Steady state 2: Bode plots!

$$H(f) = \frac{1}{1 + j\frac{f}{f_{3dB}}}$$

RC-Circuit