Laxmi Baral

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Not bad.
Need practice on
z transform.

63.5

Exam 1

1) $y(n) = x[-n]$ Linear: Yes Time Invariant: No Static: No Stable: Yes

Causal? -1.5

$y(n) = 2n^2 x(n) + n x[n+1]$ Linear: No (-1) Time Invariant: No Static: No Stable: No

$y(n) = \cos(2\pi x(n))$ Linear: Yes (-1) Time Invariant: Yes Static: Yes Stable: Yes

1b) $x(n) = \cos(\pi(2n))$ $x(t) = \cos(\Omega t)$ $f_s = 100$ Hz

$x(t) = \cos(2\Omega \cdot 50\, t)$ (π; $50\pi t$ = Ω)

$\Omega \frac{n}{100} = \frac{\pi}{2} n$ (4)

$\Omega = \frac{100\pi}{2}$, $\Omega \frac{n}{100} = \frac{3\pi}{4}$ (-3)

$\Omega = \frac{300\pi}{4}$

c) $f_s = 2$ Hz (∞) (-4)

d) $h(z) = (3z^0 + 1z^{-1})(6z^0 - 1z^{-1} + 2z^{-2} + z^{-3})$ $h(n) = 0$ × (-3)

e) $\sum_{k=0}^{\infty} A(0.7)^k B(\cos\pi(n-k))$ (i) $A_1 0.7^n \cos(0.2\pi n + \theta)$ (-5)

Total = Particular + Homogeneous
→ Input → Impulse Response

a) $y(n) = a_{1/5}\,y(n-1) + 4_{/5}\,y(n-2) + x(n)$ $\quad y(-1)=1 \quad y(-2)=-1$

a) for impulse response $x(n)=\delta(n)$

$y(n) - a_{1/5}\,y(n-1) - 4_{/5}\,y(n-2) = 0 \qquad h(n)=\left(a(-4_{/5})^n + b(4_{/3})^n\right)u(n)$

$\lambda^n - a_{1/5}\lambda^{n-1} - 4_{/5}\lambda^{n-2} = 0$ $\quad -1/5 \quad y(0)=1$

$\lambda^{n-2}(\lambda^2 - a_{1/5}\lambda - 4_{/5}) = 0 \quad \lambda = -4_{/5} \quad y(1) = a_{1/5}\,y(0) + 4_{/5}\,y(-1) + \delta(1)$

$\lambda = 4_{/3} \qquad\qquad = a_{1/5}$

$$\begin{cases} a+b=1 \\ -4_{/5}a + 4_{/3}b = a_{1/5} \end{cases} \quad a = 3/8 \quad b = 5/8$$

$$h(n) = \left\{\frac{3}{8}\left\{\frac{-1}{5}\right\}^n + \frac{5}{8}\left\{\frac{1}{3}\right\}^n\right\}u(n)$$ ✓

b) System Stable, IIR System ✓

c) $x(n)=u(n)$

$y_h(n) = h(n) = \left(a(-4_{/5})^n + b(4_{/3})^n\right)u(n) \qquad y_p(n) = H(-1)^n u(n)$ (-1) Why $(-1)^n$?

$y(n) = a_{1/5}\,y(n-1) + 4_{/5}\,y(n-2) + x(n) \quad y(-1)=1 \quad y(-2)=-1$

$H(-1)^n u(n) = H a_{1/5}(-1)^{n-1}u(n-1) + H 4_{/5}(-1)^{n-2}u(n-2) + u(n)$

$n=0 \quad H = a_{1/5}H + 4_{/5}H \qquad y(0) = x(0) = 1$

$H = 64_{/45}$ $\quad$ ZSR (-1)

$y(1) = a_{1/5}\,y(0) + 4_{/5}\,y(-1) + x(1) = a_{1/5} + 4_{/5} + 1 = 6_{/5}$

$$\begin{cases} a+b=1 \\ -4_{/5}a + 4_{/3}b = 6_{/5} \end{cases} \quad a = -13/8 \quad b = 21/8$$

$$y_{ZSR}(n) = \left\{(-13/8)(-4_{/5})^n + a_{/8}\left\{\frac{1}{3}\right\}^n\right\}u(n)$$

Where's particular? (-2)

d) $h(n) = [a(-1/6)^n + b(1/3)^n]u(n)$

$y(n) = a_{1/5}\,y(n-1) + 1/5\,y(n-2) + x(n)$

$y(0) = a_{1/5}\,y(-1) + 1/5\,y(-2) = a_{1/5} + 1/5(-1) = a_{1/5} - 1/5 = 1/5 \quad y(0) = 1/5$

$y(1) = a_{1/5}\,y(0) + 1/5\,y(-1) = a_{1/5}\cdot 1/5 + 1/5(1) = 7/25$

$\begin{cases} a+b = 1/5 & a = -1/10 \\ -1/5a + 1/3b = 7/225 & b = 1/6 \end{cases}$

$h_{ZIR} = [(-1/10)(-1/5)^n + 1/6\{1/3\}^n]u(n)$

e) $y(n) = \{(-13/8)(-1/5)^n + a_{1/8}\{1/3\}^n\}u(n) + \frac{6}{5}(-1)^n u(n)$ $K = 64/15$?

$y_{trans}(n) = y_{ZSR}(n) = \{(-13/8)(-1/5)^n + a_{1/8}\{1/3\}^n\}u(n)$

Steady State Response 0 (-1)

3) $H(z) = \frac{1+z^{-1}}{1-\frac{3}{5}z^{-1}+\frac{2}{25}z^{-2}}$ $\left\{\frac{z^2}{z^2}\right\} = \frac{z^2+z}{z^2-\frac{3}{5}z+\frac{2}{25}z} = \frac{1}{\frac{2}{15}z^{-2}-\frac{3}{5}z^{-1}+1} + \frac{1}{z+\frac{2}{15}z^{-1}-\frac{3}{5}}$ $y(n+1)$?

Use this directly.

$\frac{2}{15}y(n-2) - \frac{3}{5}y(n-1) + x(n) + y(n) + \frac{2}{15}y(n-1) - \frac{3}{15}x(n) = 0$

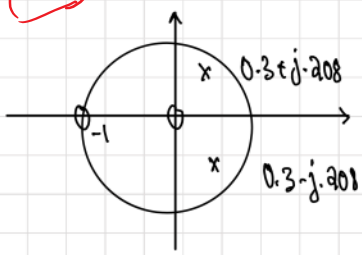
$z^2 - z = 0 \quad z = -1, z = 0$

$z^2 - \frac{3}{5}z + \frac{2}{25}z = 0$ (-3)

b) (-2)

$z = 0.3 \pm j\,0.208$ (-1)

c)



d) $0.3-j.208 < z < 0.3+j.208 = ROC$ X Causal system (-3)

e) Stable, the ROC is in the unit circle ✓

f) $x(n) = 2\,\delta(n) - 1/5\,\delta(n-1)$ (-6)