# ECE 3510 homework # Z1 Due:

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4/13/06

1. Problem 6.1 (p.215) in the Bodson text. Find $x(0)$ if the z-transform of $x(k)$ is

   a) $X(z) = \frac{a \cdot z - 1}{z - 1}$ b) $X(z) = \frac{z}{z^2 - a \cdot z + a^2}$

2. Problem 6.3 in the text. Use partial fraction expansions to find the $x(k)$ whose z-transform is

   a) $X(z) = \frac{1}{(z-1)\cdot(z-2)}$ b) $X(z) = \frac{z}{z^2 - 2 \cdot z + 2}$

3. Problem 6.4 in the text. Sketch the time function $x(k)$ that you would associate with the following poles. Only a sketch is required, but be as precise as possible.

   a) $p_1 = 0.9 \cdot j$, $= -0.9 \cdot j$ b) $p_1 = 1$, $p_2 = -1$ c) $p_1 = 0.3$, $p_2 = 0.9$ d) $p_1 = e^{j \cdot \frac{\pi}{6}}$, $p_2 = e^{-j \cdot \frac{\pi}{6}}$

# homework # Z2 Due:

1. Problem 6.6 (p.217) in the Bodson text.
2. Problem 6.7 in the text.
3. Problem 6.8 in the text
4. Problem 6.9 in the text
5. Problem 6.10 in the text b) hint: find y(k) by partial fraction expansion, then $\frac{y(k)}{y(k-1)}$ and then let k -> ∞ .

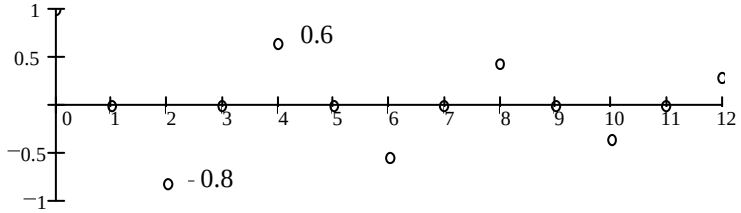
# homework # Z3 Due:

1. Problem 6.11 (p.219) in the Bodson text.
2. Problem 6.12 in the text.
   Hints: $r(k) = r \cdot u(k)$ Find $\frac{e(z)}{R(z)}$ and make sure its poles are inside unit circle
3. Problem 7.1 (p.253) in the Bodson text.
4. Problem 7.2 in the text

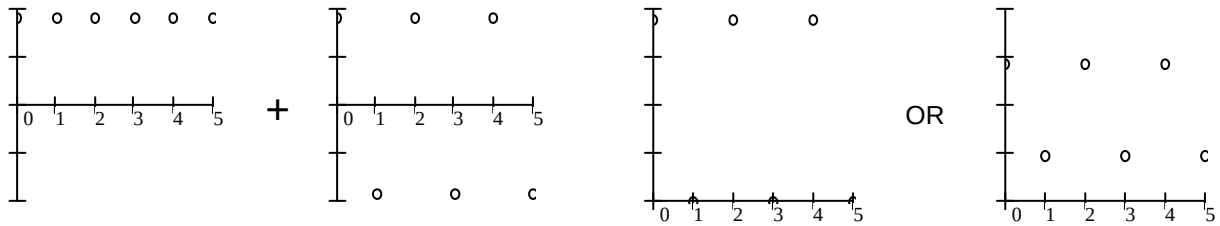
**Z1 Answers**

1. a) a b) 0 2. a) $\frac{1}{2} \cdot \delta(k) - 1 + \frac{1}{2} \cdot 2^k$ b) $\left(\sqrt{2}\right)^k \cdot \sin\left(\frac{\pi}{4} \cdot k\right)$
3. Actual signals may have different magnitudes and/or phase angles. You can't tell those things from the pole locations.

   a) $x(k) = 0.9^k \cdot \cos\left(\frac{\pi}{2} \cdot k\right)$

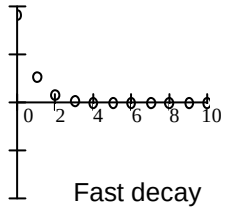



   b)



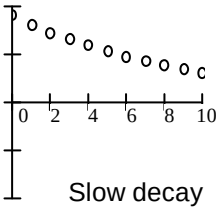

Or many others, depending on relative magnitudes

c)

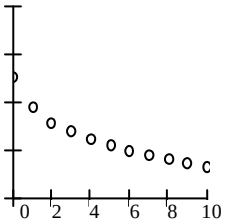



Fast decay

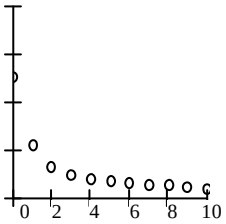
+




Slow decay

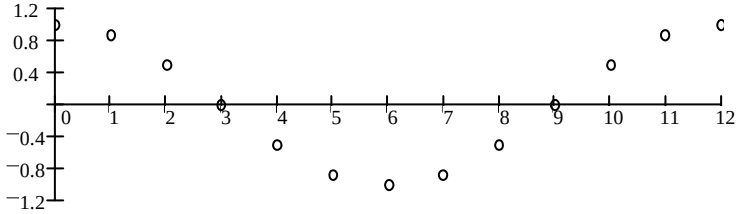



OR




Or many others, depending on relative magnitudes

d) $x(k) = \cos\left(\frac{\pi}{6}\cdot k\right)$




**Z2 Answers**

1. (6.6) a) $x(k) := -4\cdot\delta(k) + 2 + 2\cdot\sqrt{2}\cdot\cos\left(\frac{\pi}{2}\cdot k + \frac{\pi}{4}\right)$

$x(0) = 0$ $x(1) = 0$ $x(2) = 0$ $x(3) = 4$ $x(4) = 4$ $x(5) = 0$ $x(6) = 0$ $x(7) = 4$ $x(8) = 4$

2. (6.7)

| | Bounded | Converges | x(∞) | |
|---|---|---|---|---|
| a) | yes | yes | 0 | |
| b) | yes | yes | 0 | vanishes in a finite time (all poles are at zero) |
| c) | yes | no | | |
| d) | yes | yes | 8/9 | |
| e) | yes | yes | 2 | |
| f) | no | | | |
| g) | yes | no | | |
| h) | yes | yes | 1 | |

3. (6.8) a) yes
b) yes
c) no
d) yes
e) no
f) yes

4. (6.9) a) $H(z) = \frac{z^2}{z^2 - a\cdot z + a^2}$ stable if: $|a| < 1$ b) $H(z) = \frac{12\cdot z^2 + 48\cdot z - 3}{z\cdot(2\cdot z - 1)}$ stable

5. (6.10) a) $H(z) = \frac{z^2}{z^2 - z - 1}$ unstable b) $\frac{1+\sqrt{5}}{2} = 1.618$

**Z3 Answers**

1. (6.11) a) gain = $-\frac{2}{3}$ $y_{ss} = -2$ b) $2\cdot e^{j\cdot\frac{\pi}{2}}$ (frequency response) $-2\cdot\sin\left(\frac{\pi}{2}\cdot k\right)$

2. (6.12) $a = 1$ $g < 1$

3. (7.1) a) $H_d(z) = \frac{z\cdot\left(T - 1 + e^{-T}\right) + \left(1 - e^{-T} - T\cdot e^{-T}\right)}{(z-1)\cdot\left(z - e^{-T}\right)}$ b) $H_d(z) = \frac{(1-\cos(T))\cdot(z+1)}{z^2 - 2\cdot\cos(T)\cdot z + 1} = 0$ @ $T = 2\cdot\pi$

4. (7.2) $60\cdot Hz$