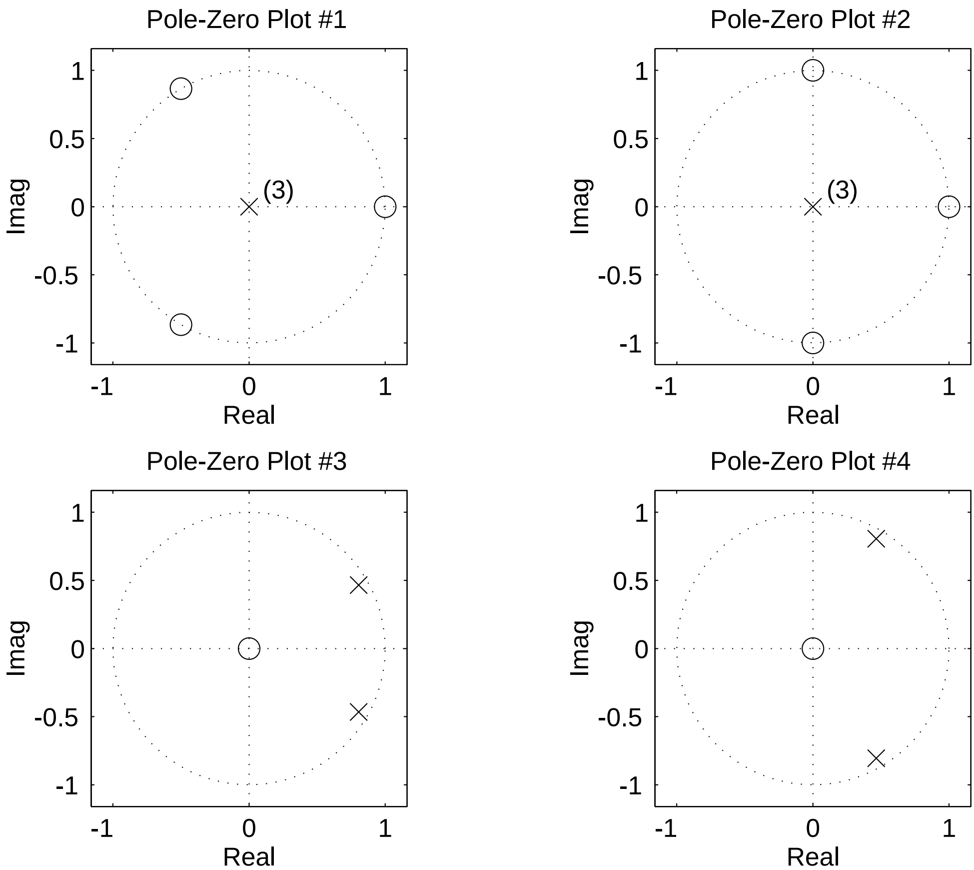
PROBLEM:



For each of the pole-zero plots (#1, #2, #3, #4) determine which one of the following systems (specified by either an $H(z)$ or a difference equation) matches the frequency response.

$\mathcal{S}_0$: $\quad y[n] = 0.93y[n-1] + x[n-1]$

$\mathcal{S}_1$: $\quad H(z) = \dfrac{z^{-1}}{1 - 1.315z^{-1} + 0.8649z^{-2}}$

$\mathcal{S}_2$: $\quad H(z) = \dfrac{z^{-1}}{1 - 1.61z^{-1} + 0.8649z^{-2}}$

$\mathcal{S}_3$: $\quad H(z) = \dfrac{z^{-1}}{1 - 0.93z^{-1} + 0.8649z^{-2}}$

$\mathcal{S}_4$: $\quad H(z) = (1 - z^{-1})^3$

$\mathcal{S}_5$: $\quad H(z) = 1 - z^{-1} + z^{-2} - z^{-3}$

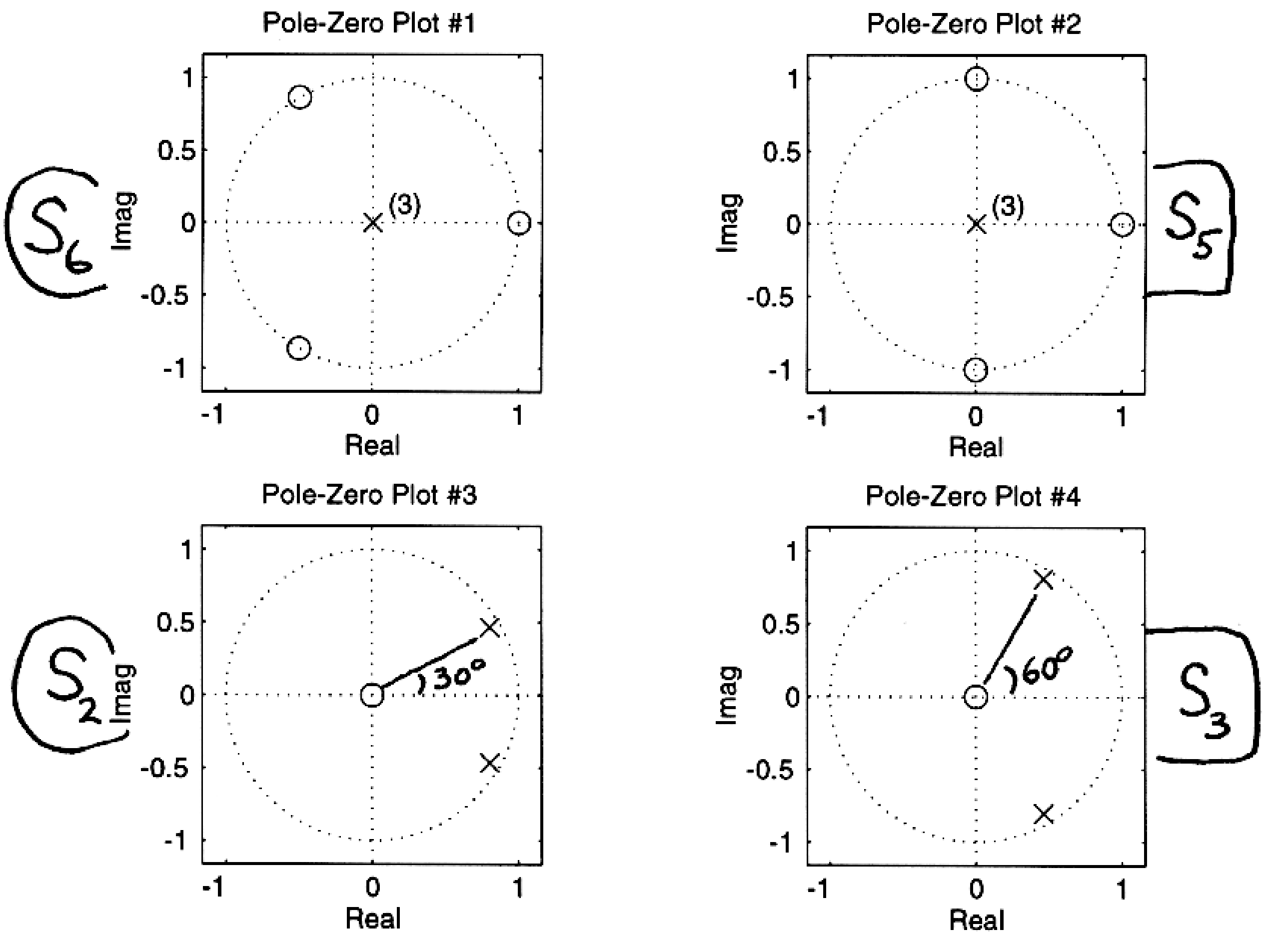
$\mathcal{S}_6$: $\quad y[n] = x[n] - x[n-3]$

$\mathcal{S}_7$: $\quad y[n] = \sum_{k=0}^{3} x[n-k]$

$\mathcal{S}_8$: $\quad y[n] = x[n] + 2x[n-1] + 3x[n-2] + 2x[n-3] + x[n-4]$

McClellan, Schafer and Yoder, *Signal Processing First*, ISBN 0-13-065562-7.
Prentice Hall, Upper Saddle River, NJ 07458. © 2003 Pearson Education, Inc.

SOLUTION



For each of the pole-zero plots (#1, #2, #3, #4) determine which one of the following systems (specified by either an $H(z)$ or a difference equation) matches the frequency response.

S_0 : $y[n] = 0.93y[n-1] + x[n-1]$ → $H(z) = \dfrac{z^{-1}}{1-0.93z^{-1}}$ ⇒ 1 real pole

S_1 : $H(z) = \dfrac{z^{-1}}{1 - 1.315z^{-1} + 0.8649z^{-2}}$ → poles at $0.93\angle\pm 45^\circ$

S_2 : $H(z) = \dfrac{z^{-1}}{1 - 1.61z^{-1} + 0.8649z^{-2}}$ → poles at $0.93\angle\pm 30^\circ$

S_3 : $H(z) = \dfrac{z^{-1}}{1 - 0.93z^{-1} + 0.8649z^{-2}}$ → poles at $0.93\angle\pm 60^\circ$

S_4 : $H(z) = (1 - z^{-1})^3$ → Three zeros, all at $z=1$

S_5 : $H(z) = 1 - z^{-1} + z^{-2} - z^{-3}$ → $z=1$ is a root; also $z=\pm j$

S_6 : $y[n] = x[n] - x[n-3]$ → $H(z) = 1 - z^{-3}$ ⇒ $z = e^{j2\pi\ell/3}$ are roots

S_7 : $y[n] = \sum_{k=0}^{3} x[n-k]$ → $H(z) = 1 + z^{-1} + z^{-2} + z^{-3}$ ⇒ $z=-1$ is a root

S_8 : $y[n] = x[n] + 2x[n-1] + 3x[n-2] + 2x[n-3] + x[n-4]$

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