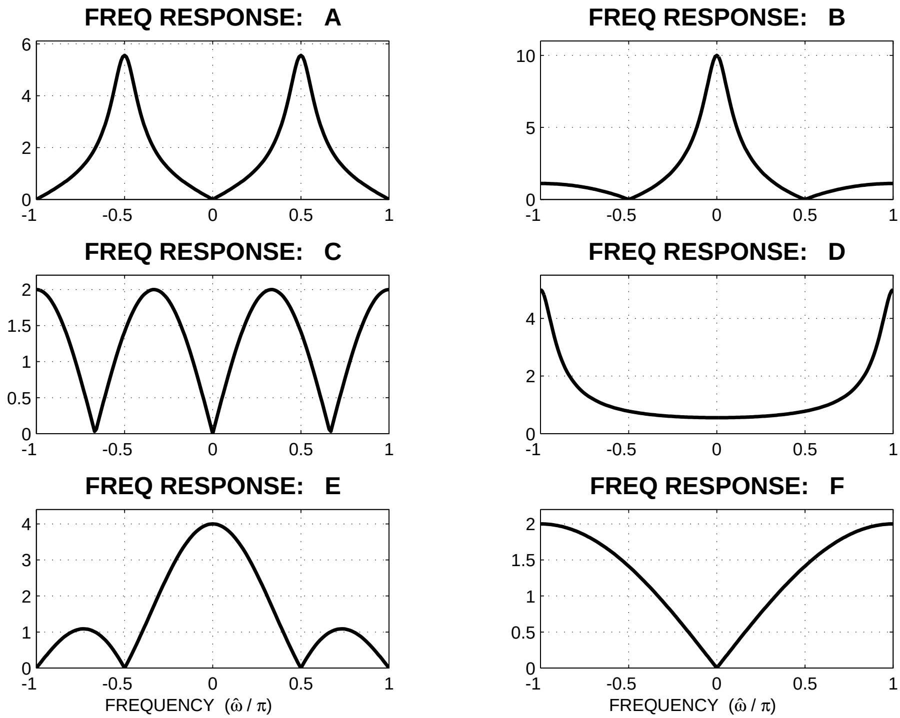
PROBLEM:



For each of the frequency response plots (A, B, C, D, E, F), determine which one of the following systems (specified by either an $H(z)$, a difference equation, or a MATLAB statement) matches the frequency response (magnitude only). *There is only ONE correct match per graph.* NOTE: The discrete-time frequency axis is **normalized**; it is $\hat{\omega}/\pi$.

$\mathcal{S}_1$: $y[n] = -0.8y[n-1] + x[n]$

$\mathcal{S}_2$: H=freqz([1,0,1],[1,0,0.64],omega)

$\mathcal{S}_3$: $H(z) = \sum_{k=0}^{3} z^{-k}$

$\mathcal{S}_4$: $H(z) = \dfrac{1+z^{-2}}{1-0.8z^{-1}}$

$\mathcal{S}_5$: $H(z) = 1 + 0.64z^{-2}$

$\mathcal{S}_6$: $H(z) = \dfrac{1-z^{-2}}{1+0.64z^{-2}}$

$\mathcal{S}_7$: $y[n] = x[n] - x[n-1]$

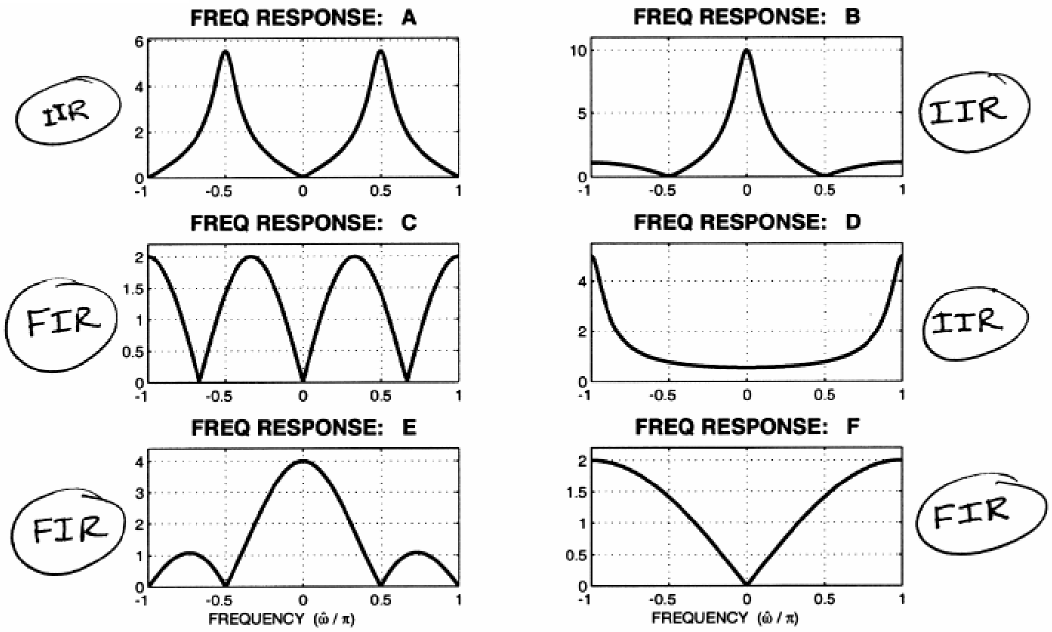
$\mathcal{S}_8$: $H(z) = 1 - z^{-3}$

Mark your answer in the following table:

FREQUENCY RESPONSE	SYSTEM ($\mathcal{S}_{\#}$)	FREQUENCY RESPONSE	SYSTEM ($\mathcal{S}_{\#}$)
A		B	
C		D	
E		F	

McClellan, Schafer and Yoder, *Signal Processing First*, ISBN 0-13-065562-7.

SOLUTION



For each of the frequency response plots (A, B, C, D, E, F), determine which one of the following systems (specified by either an $H(z)$, a difference equation, or a MATLAB statement) matches the frequency response (magnitude only). *There is only ONE correct match per graph.* NOTE: The discrete-time frequency axis is **normalized**; it is $\hat{\omega}/\pi$.

$\mathcal{S}_1$: $y[n] = -0.8y[n-1] + x[n]$

$H_1(z) = \dfrac{1}{1+0.8z^{-1}}$

$\mathcal{S}_2$: H=freqz([1,0,1],[1,0,0.64],omega)

$\mathcal{S}_3$: $H(z) = \sum_{k=0}^{3} z^{-k} = \dfrac{1-z^{-4}}{1-z^{-1}}$ zeros at $z=-1, \pm j$ $\Rightarrow \hat{\omega} = \pi, \pm\pi/2$

$\mathcal{S}_4$: $H(z) = \dfrac{1+z^{-2}}{1-0.8z^{-1}}$

$\mathcal{S}_5$: $H(z) = 1 + 0.64z^{-2}$ ← NO zeros on U.C.

$\mathcal{S}_6$: $H(z) = \dfrac{1-z^{-2}}{1+0.64z^{-2}}$ ← zeros at $z=\pm 1$ $\Rightarrow \hat{\omega} = 0, \pi$

$\mathcal{S}_7$: $y[n] = x[n] - x[n-1]$ $H(e^{j\hat{\omega}}) = 1 - e^{-j\hat{\omega}}$

zero @ $\hat{\omega}=0$
$=2$ @ $\hat{\omega}=\pi$

$\mathcal{S}_8$: $H(z) = 1 - z^{-3}$

zeros at $z = 1, e^{\pm j2\pi/3}$
$\Rightarrow \hat{\omega} = 0, \pm 2\pi/3$

Mark your answer in the following table: → $H_2(z) = \dfrac{1+z^{-2}}{1+0.64z^{-2}}$ ← zeros at $z=\pm j$ $\Rightarrow \hat{\omega} = \pm\pi/2$.

FREQUENCY RESPONSE	SYSTEM ($\mathcal{S}_\#$)	FREQUENCY RESPONSE	SYSTEM ($\mathcal{S}_\#$)
A	S_6 6	B	S_4 4
C	S_8 8	D	S_1 1
E	S_3 3	F	S_7 7

DC values: S_1 is $\frac{1}{1.8} \approx .6$ S_3 is 4 S_5 is 1.64

S_2 is $\frac{2}{1.64} \approx 1.25$ S_4 is $\frac{2}{.2} = 10$ S_6, S_7, S_8 are 0 at $\hat{\omega}=0$ or $z=1$

at $\hat{\omega}=\pi$, S_1 is $\frac{1}{1-.8} = \frac{1}{.2} = 5$