ECE 351 DSP: Practice Problems 2

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1) Consider the system shown in Figure 1. Draw the implementation of the system that takes $y[n]$ as input and outputs $x[n]$. Is this new system stable?

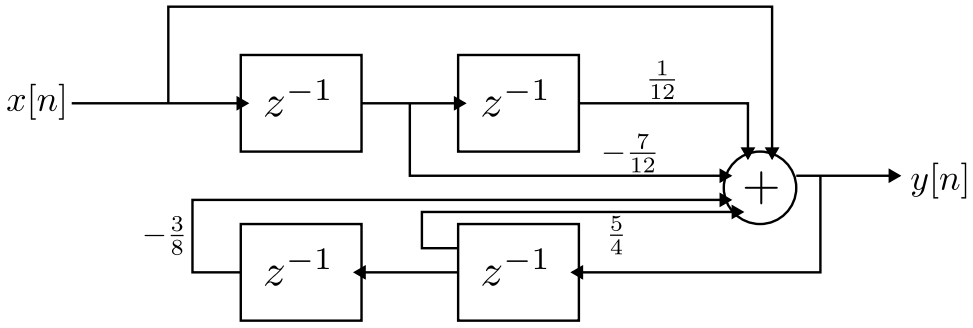

Fig. 1: The system for question 1

2) Consider the max-phase system given by $H(z) = \frac{(1-\frac{5}{4}z^{-1})(1-\frac{6}{5}z^{-1})}{(1-\frac{3}{4}z^{-1})(1-\frac{1}{6}z^{-1})}$. Show that it can be viewed as a cascade of a min-phase system and an all pass filter.

3) Consider the system whose impulse response appears in Figure 2. What is its group delay?

The number on the top of the bars in Figure 2 represents the value of $h[n]$ at that instance.

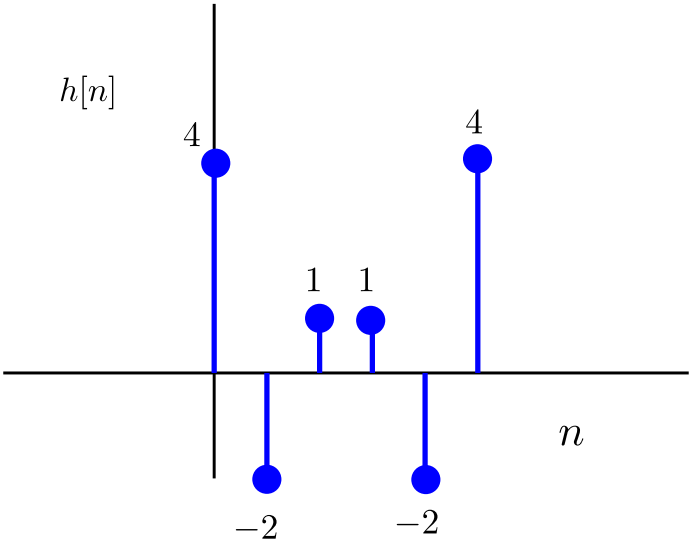

Fig. 2: The system for question 3

4) Design an FIR filter that completely blocks the frequency $\omega_0 = \frac{\pi}{4}$.

[**Note:** You are asked to design an FIR filter, but the notch filter taught in class is IIR,and hence that is not the answer. Make sure your filter is real, and has a maximum amplitude response of 1.]

ANSWERS

1) The system is stable. The implementation appears in Figure 3.

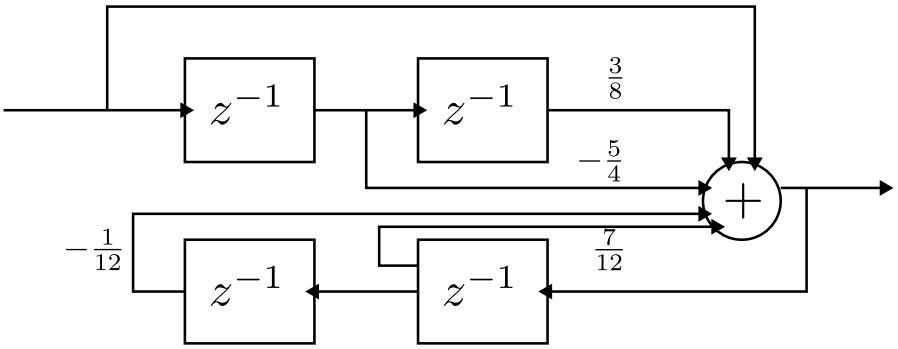

Fig. 3: The system for the answer to question 1

2) Min-phase: $\frac{3}{2}\frac{(1-\frac{4}{5}z^{-1})(1-\frac{5}{6}z^{-1})}{(1-\frac{3}{4}z^{-1})(1-\frac{1}{6}z^{-1})}$
   All Pass: $\frac{\frac{2}{3}-\frac{49}{30}z^{-1}+z^{-2}}{1-\frac{49}{30}z^{-1}+\frac{2}{3}z^{-2}}$.

3) 2.5.

4) $H(z) = \frac{1}{2+\sqrt{2}}(1-\sqrt{2}z^{-1}+z^{-2})$.