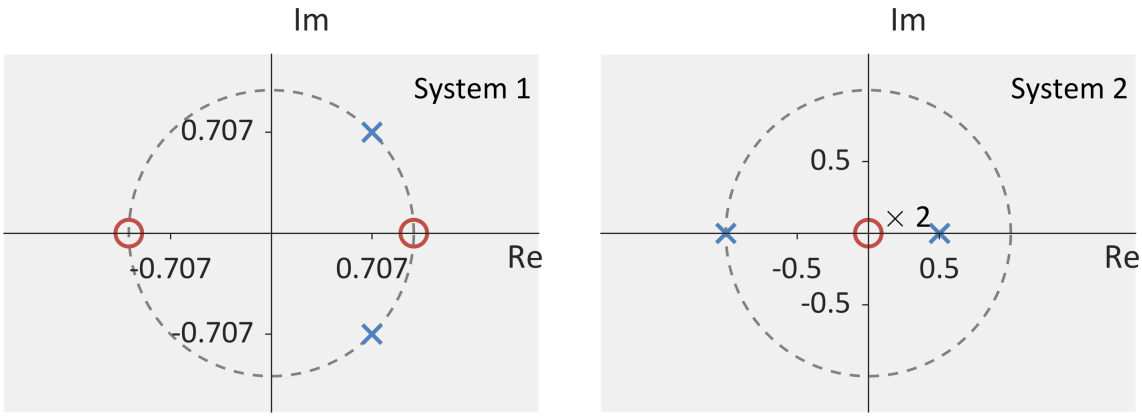
Full Name: _____

EEE 5502 (Fall 2022) – Practice **Oct. 20, 2022**

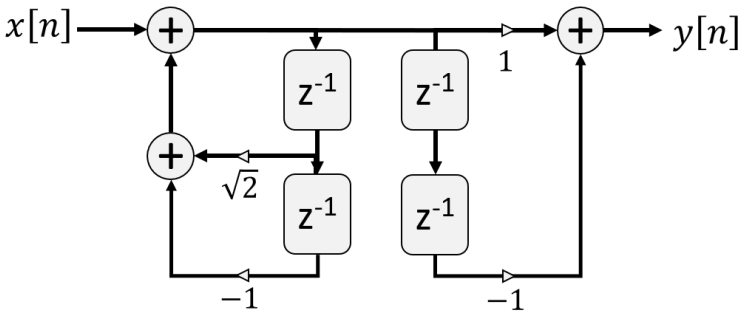
Question #1: Consider the systems given by the following pole-zero plots.



(a) Draw a block diagram of the IIR cascade of a FIR filter and poles-only IIR filter for System 1 (Note: this is the same as Direct Form I). Design the implementation so that complex conjugate pairs are together. **Ensure that you use real values on the connections in the block diagram**.

Solution:

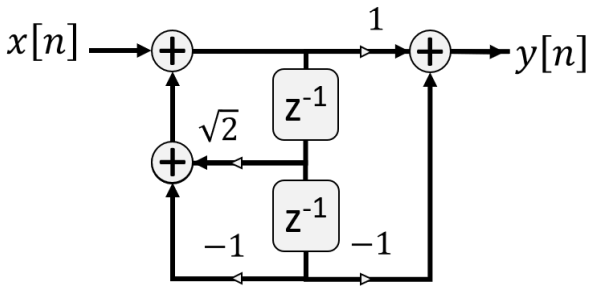
$$\begin{aligned} H(z) &= \frac{\left(1 - z^{-1}\right)\left(1 + z^{-1}\right)}{\left(1 - z^{-1}e^{j\pi/4}\right)\left(1 - z^{-1}e^{-j\pi/4}\right)} \\ &= \frac{1 - z^{-2}}{1 - 2\cos(\pi/4)z^{-1} + z^{-2}} \\ &= \frac{1 - z^{-2}}{1 - \sqrt{2}z^{-1} + z^{-2}} \end{aligned}$$



(b) Draw a block diagram of the IIR direct form II implementation for System 1. Design the implementation so that complex conjugate pairs are together. **Ensure that you use real values on the connections in the block diagram**.

Solution:

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



(c) Draw a block diagram of the IIR parallel form implementation for System 2. **You may use complex values for the connections in the block diagram**.

Solution:

$$H(z) = \frac{1}{(1 - 0.5z^{-1})(1 + z^{-1})}$$
$$= \frac{2/3}{1 + z^{-1}} + \frac{1/3}{1 - (1/2)z^{-1}}$$