Full Name: _____

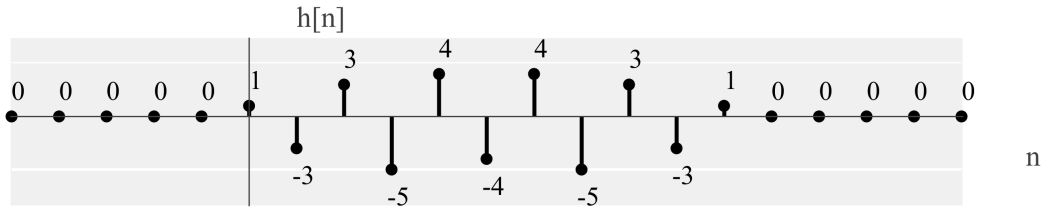
EEL 4750 / EEE 5502 (Fall 2018) – HW #08 **Due Date: Oct. 26, 2018**

Homework learning objectives: By the end of this homework, you should be able to:

- Solve for the phase of a discrete-time transfer function
- Understand different filter implementations

Question #1: *(1 pts)* How many hours did you spend on this homework?

Question #2: *(8 pts)* Consider the following discrete-time impulse response $h[n]$.



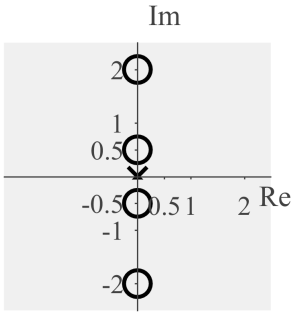
(a) Determine the phase of the DTFT of $x[n]$ (i.e., $H(\omega)$). (*Hint: Do not compute the DTFT*)

(b) Determine the group delay of the DTFT of $x[n]$ (i.e., $H(\omega)$).

(c) Determine the phase of $-H(\omega)$.

(d) Determine the phase of $H(\omega)(1 + e^{-j\omega})$.

Question #3: *(6 pts)* Consider the causal system defined by the pole-zero plot below. Assume there is no additional gain on the system (i.e., gain= 1). Note: there are four poles at the origin.

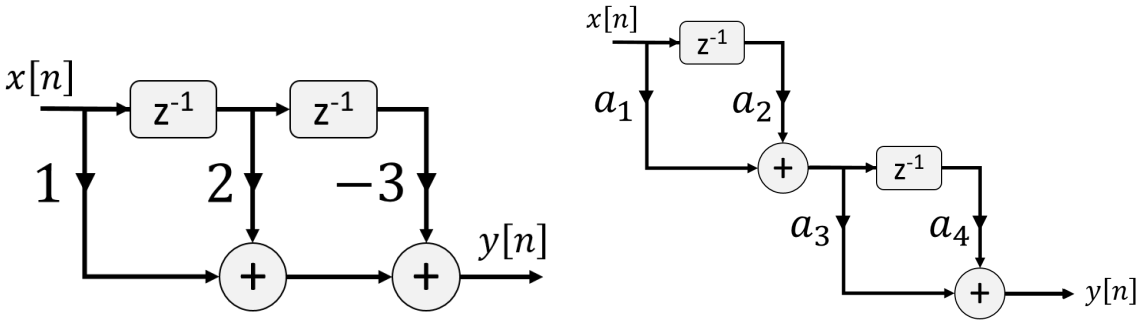


(a) Determine the phase of the DTFT of $x[n]$ (i.e., $X(\omega)$).

(b) Determine the group delay of the DTFT of $x[n]$ (i.e., $X(\omega)$).

(c) Determine the phase of $\frac{1}{2}\left[X(\omega - \pi/2) + X(\omega - \pi/2)\right]$.

Question #4: *(8 pts)* Consider the FIR direct form (left) and the FIR cascade form (right) implementations below.



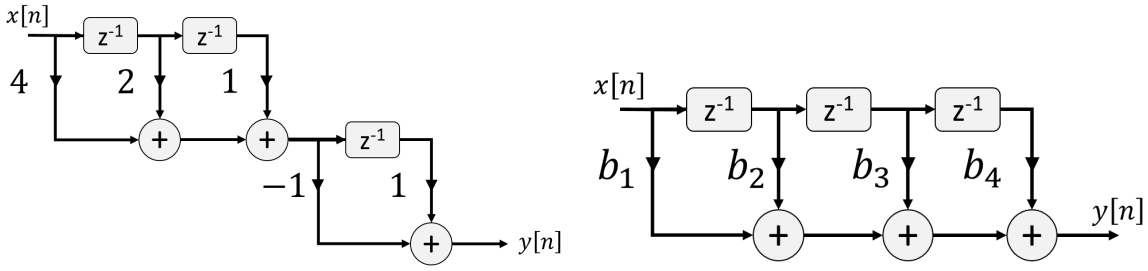
(a) Write the difference equation corresponding to the FIR direct form implementation.

(b) Write the Z-transform transfer function corresponding to the FIR direct form implementation.

(c) Sketch the pole-zero plot for the FIR direct form.

(d) Determine the unknown coefficient weights for the FIR cascade form so that the two forms represent equivalent systems.

Question #5: *(10 pts)* Consider the FIR cascade form (left) and the FIR direct form (right) implementations below.



(a) Write the z-transform transfer function corresponding to the FIR cascade form.

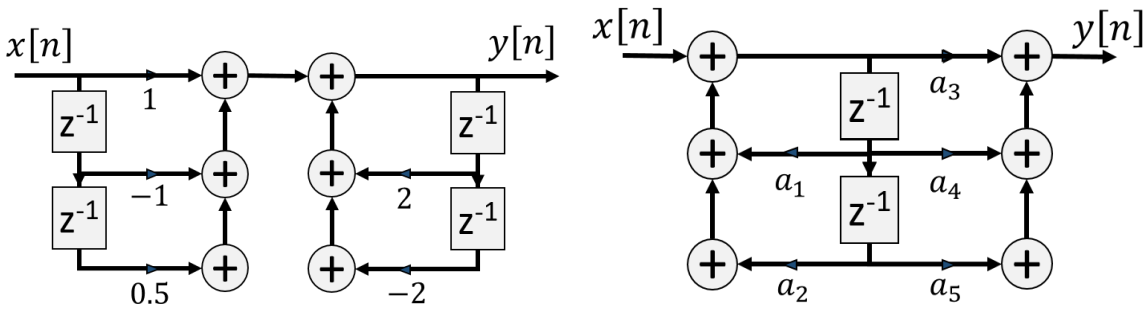
(b) Write the difference equation corresponding to the FIR cascade form implementation.

(c) Sketch the pole-zero plot for the FIR direct form.

(d) Is the system stable?

(e) Determine the unknown coefficient weights for the FIR direct form so that the two forms represent equivalent systems.

Question #6: *(10 pts)* Consider the direct form I (left) and the direct form II (right) implementations below.



(a) Write the difference equation corresponding to the direct form I implementation.

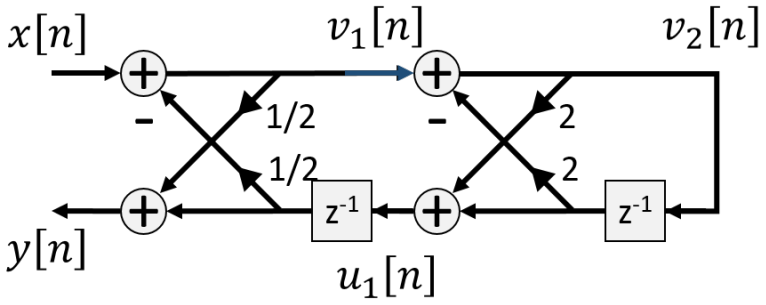
(b) Write the z-transform transfer function corresponding to the direct form I implementation.

(c) Sketch the pole-zero plot for the FIR direct form.

(d) Is this a low pass, high pass, band pass, all pass, or none filter?

(e) Determine the unknown coefficient weights for the direct form II so that the two forms represent equivalent systems.

Question #7: *(6 pts)* Consider the lattice filter implementation below.



(a) Compute the z-transform transfer function for $Y(z)/X(z)$

(b) Compute the z-transform transfer function for $V_2(z)/X(z)$

(c) Compute the z-transform transfer function for $Y(z)/V_2(z)$