EE 120 SIGNALS AND SYSTEMS, Fall 2019
Homework # 6
For self study; do not turn in.

1. Find the right-sided sequence whose z-transform is:

$$X(z) = \frac{1 - 2z^{-1}}{1 + \frac{5}{2}z^{-1} + z^{-2}}.$$

2. Consider the causal LTI system defined by the difference equation:

$$y[n] - \frac{3}{2}y[n-1] + \frac{1}{2}y[n-2] = x[n]. \qquad (1)$$

a) Find the transfer function and its region of convergence.

b) Determine if the system is stable.

c) Using z-transforms determine the output $y[n]$ when

$$x[n] = u[n].$$

3. Consider the discrete-time causal LTI system whose transfer function is:

$$H(z) = \frac{0.05634(1 + z^{-1})(1 - 1.0166z^{-1} + z^{-2})}{(1 - 0.683z^{-1})(1 - 1.4461z^{-1} + 0.7957z^{-2})}.$$

a) Mark the poles and zeros in the complex plane. Is the system stable?

b) Use the geometric approach to make a rough plot for the magnitude of the frequency response, $|H(e^{j\omega})|$.

4. Consider the band-stop filter discussed in Lecture 22:

$$H_{bs}(z) = \frac{1+\alpha}{2}\frac{1 - 2\beta z^{-1} + z^{-2}}{1 - \beta(1+\alpha)z^{-1} + \alpha z^{-2}} \quad |\beta| < 1 \;\; |\alpha| < 1.$$

a) Find the frequency $\omega_0 \in [0, \pi]$ such that $H_{bs}(e^{j\omega_0}) = 0$.

b) Show that $H_{bs}(e^{j\omega}) = 1$ when $\omega = 0$ and $\omega = \pi$.

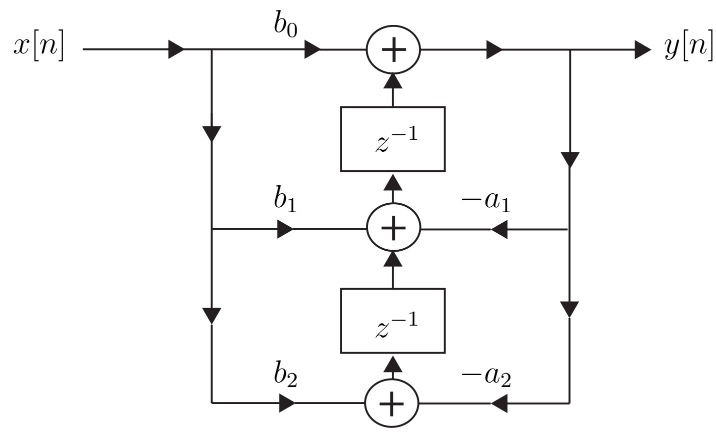
5. Now consider the band-pass filter discussed in Lecture 22:

$$H_{bp}(z) = \frac{1-\alpha}{2}\frac{1 - z^{-2}}{1 - \beta(1+\alpha)z^{-1} + \alpha z^{-2}}, \quad |\alpha| < 1 \;\; |\beta| < 1$$

a) Show that $H_{bp}(z) + H_{bs}(z) = 1$, where $H_{bs}(z)$ is as in Problem 4.

b) Find $H_{bp}(e^{j\omega})$ for $\omega = 0$, $\omega = \pi$, and $\omega = \omega_0$ where ω_0 is as in Problem 4(a).

6. Find the transfer function for the system implemented by the block diagram below:



7. Consider the difference equation (1) in Problem 2 with $x[n] = 0$ for all n. Suppose $y[-2] = 5$ and $y[-1] = 3$. Use unilateral z-transforms to solve for $y[n]$ for $n \geq 0$.