EECS 360
Spring 2021
Discrete Filtering

1. Given X(z) = 5 + $4z^{-1}$ + $3z^{-2}$+$2z^{-3}$ +z^{-4} find x[n].

2. Show that $X(z)=5 + 4z^{-1} + 3z^{-2}+2z^{-3}+1z^{-4}=\frac{5z^4 + 4z^3 + 3z^2+2z+1}{z^4}$

3. Given $X(z)=\frac{z^4 + 2z^3 + 3z^2+4z+5}{z^4}$ find x[n].

4. A system is described by $y[n]=x[n]+2x[n-1]+.75y[n-1]-.125y[n-2]$
   a. Find the transfer function H(z).
   b. Find the poles and zeros.
   c. Draw the pole-zero diagram.
   d. Is this a stable system?

5. Is a system with a transfer function $H(z)=\frac{z(z+2)}{(z-1.5)(z+.5)}$ stable and why?

6. Given a system transfer function $H(z)=\frac{z^2}{(z-(.5+j.8))(z-(.5-j.8))}$
   a. Draw the pole-zero diagram.
   b. Is this a stable system?
   c. An analog signal x(t)=cos(2π160t) is sampled at 1000 samples/sec to form x[n]. Find the output y[n] with x[n] input to this filter.
   d. This a BPF, what is its center frequency.
   e. What is the discrete time implementation of this system?
   f. Confirm your answer using

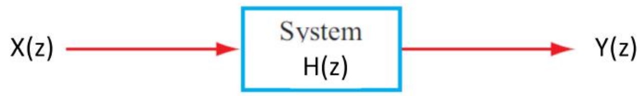
http://demonstrations.wolfram.com/TransferFunctionAnalysisByManipulationOfPolesAndZeros

7. Design a discrete time system, that is find H(z) and its discrete time implementation to reject an analog signal x(t)=cos(2π160t) which is sampled at 1000 samples/sec to form x[n]. Validate your design using

http://demonstrations.wolfram.com/TransferFunctionAnalysisByManipulationOfPolesAndZeros
This tool may not let you get the exact zero locations, so use it to get close to your design answer.

8. Given $H(z)=\frac{z^2}{z^2-2r\cos(\theta)z+r^2}$ show that the poles are at $r\cos(\theta)\pm jr\sin(\theta)$.

9. Given an open loop transfer function $H(z) = \frac{z}{z-5}$ find the feedback system, G(z), that will stabilize H(z).



(a) **Open-loop system**