Digital Signal Processing ENGR 4333/5333

Final

Date: 12/09/2020, Wednesday **Time: 3:00 – 4:50 p.m.** **Name:**

Q1) Determine the transfer function $H(z)$ for the system described by the difference equation

$$y[n+2] + 5y[n+1] + 6y[n] = 5x[n+1].$$

Q2) A causal system whose transfer function is $H(z) = \frac{z}{z^2+0.2z-0.48}$

a) Find the impulse response $h[n]$
b) Find $h[n]$ if the above $H(z)$ is modified such that its numerator is ze^{-5z}. **Hint:** use the answer in part a.
c) What is the impact of the modification in part **b** on the system behavior?

Q3) Using the definition to find the z-transforms, including ROCs, of the signal $x[n] = 9 - n$ for $0 \le n \le 9$. After you evaluate the summation, you do not need to simplify your answer any further.

Q4) A system is described as $y[n+1] - 0.3y[n] = 3x[n+1]$, with $y[-1] = 1$, and input $x[n] = (0.5)^n u[n]$.
a) Determine the zero-input response $y_{zi}[n]$.
b) Determine the zero-state response $y_{zs}[n]$.

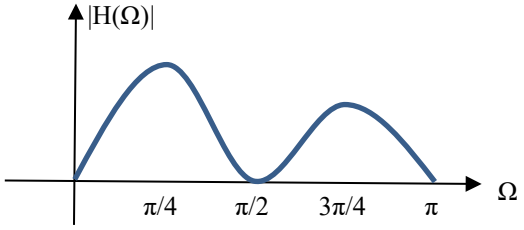
Q5) A system has the transfer function $H(z) = \frac{z+2}{z(z-2j)(z+2j)}$

a) Determine the poles and the zeros of the system.
b) Is this system stable? Explain.
c) Find the frequency response of the system $H(\Omega)$

Q6) For the system with the transfer function $H(z) = \frac{3z^2-1.8}{z^2-z+0.16}$

a) Find the direct form II realization
b) Find the transpose direct form II realization
c) Find the difference equation that describe the system.

Q7) Design and state the transfer function $H(z)$ of the digital filter that has the frequency response shown below. Plot the poles and zeros on the z-plane and find the frequencies in Hz for $\pi/4$ and $3\pi/4$ if the sampling rate is 16 kHz. You do not need to find the exact distances from the center of the unit circle to the poles, label them as d_1, d_2, and so forth. However, you need to indicate which distance is the largest to create the peaks at $\pi/4$ and $3\pi/4$.



Bonus: Do problem 4 part c in homework 10 for chapter 7.