**Digital Signal Processing ENGR 4333/5333**

**Final**

**Time:** 3:00 – 4:50 PM **Date:** 12/14/2023  **Name:**

**Q1)** For the system described by the difference equation, Determine the system frequency response *H*(*Ω*) of the system,

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

1. Find the system frequency response *H*(*Ω*)
2. Find the system response to the input *x*[*n*] = 2cos(π*n*)

**Q2)** For the signal *x*[*n*] = (0*.*7)*nu*[*n*-1]*.*

1. Find the DTFT *X*(Ω) using the definition.
2. Find the DTFT *X*(Ω) using the table and time shifting property.

**Q3)** Draw the Form II realization of the following system,

 $H\left(z\right)=\frac{z^{2}-2}{z^{2}+3z+8}$

**Q4)** For the following system

$$H\left(z\right)=\frac{\left(z-1\right)\left(z+1\right)}{(z-0.8e^{jπ/2})(z-0.8e^{-jπ/2})}$$

1. Plot the poles and zeros in the z-plane.
2. From the location of the poles and zeros plot the magnitude |*H*(ejΩ)| for 0 ≤ Ω ≤ π. You need to label the frequencies at which the magnitude is maximum and minimum. You don’t need to determine the exact magnitude of the |*H*(ejΩ)|.
3. The sampling frequency is 8000 samples/sec. What are the frequencies in Hz at which the response will be maximum and minimum?

**Q5)** For the signal *x*[*n*] = δ[*n*] + 2δ[*n*-1] + δ[*n*-2]

1. Find the DFT *X*[*k*]. You don’t need to evaluate *X*[*k*] at different values of *k*.
2. What is the frequency resolution *Ω*o.
3. How can we achieve a DFT frequency resolution of Ωo = 0.1π for *X*[*k*]?

**Q6)** A signal *x*[*n*] of 10 samples is the input to a system whose impulse response *h*[*n*] consists of 5 samples.

1. What is the length of the output *y*[*n*]?
2. If you want to find the output *y*[*n*] using the DFT method, then explain the steps to achieve that.