Full Name: _____ **Lab Section:** _____

EEL 4750 / EEE 5502 (Fall 2018) – HW #04 **Due Date: Sept. 20, 2018**

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

- Compute the z-transform of a signal
- Determine the poles, zeros, region of convergence, and stability for a system
- Compute the forward and inverse discrete-time Fourier Transform of a signal

Question #1: *(2 pts)* How many hours did you spend on this homework?

Question #2: *(10 pts)* For each of the following impulse responses,

- Compute the Z-transform
- Plot the pole-zero plot and the region of convergence
- Answer if the system is stable or unstable

(a) $h[n] = \delta[n] + 2\delta[n-1]$

(b) $h[n] = (0.25)^n u[n]$

(c) $h[n] = (0.2)^n u[-n-1] - (2)^n u[n]$

(d) $h[n] = (1/3)^n u[n] * (2)^n u[n] * (3)^n u[n]$

(e) $h[n] = (1/2)^{|n|}$

Question #3: *(10 pts)* For each of the following z-transforms,

- ***Do not*** compute the inverse Z-transform
- Plot the pole-zero plot and the region of convergence
- Answer if the system is stable or unstable

Use the discrete-time transform tables on the course website.

(a) $H(z) = \dfrac{10}{10 - z^{-1}}$ (assume the system is *causal*)

(b) $H(z) = \dfrac{z^2 + 1}{(z-4)^2 + 16}$ (assume the system is *causal*)

(c) $H(z) = \dfrac{z^2 + 1}{(z-4)^2 + 16}$ (assume the system is *anti-causal*)

(d) $H(z) = \dfrac{(z+4)(z+5)}{z^2 + z + 1/4}$ (assume the system is *anti-causal*)

(e) $H(z) = \dfrac{\left(1 - z^{-1}\right)\left(1 + (1/4)z^{-1}\right)}{\left(1 + 4z^{-2}\right)\left(1 - (1/2)z^{-1}\right)}$ (assume the system is *stable*)

Question #4: *(8 pts)* Determine the impulse responses $h[n]$ for the following difference equations. Assume each difference equations represent causal systems.

(a) $y[n] - (1.8)y[n-1] = x[n]$

(b) $y[n] - (1.8)y[n-1] = x[n-1] + 2x[n-2]$

(c) $y[n] - 3y[n-1] + 2y[n-2] = x[n]$

(d) $y[n-1] - 3y[n-2] + 2y[n-3] = x[n]$

Question #5: *(10 pts)* Determine the discrete-time Fourier transform (DTFT) of $x[n]$ for the following difference equations. Use the discrete-time transform tables on the course website.

(a) $x[n] = (0.2)^n u[n]$

(b) $x[n] = (0.2)^{n-12} u[n-12]$

(c) $x[n] = (0.2)^{n-11} u[n-12]$

(d) $x[n] = (0.2)^{-n-12} u[-n-12]$

(e) $x[n] = (0.2)^{n-12} u[n-12] * (0.2)^{n+12} u[n+12]$

Question #6: *(8 pts)* Compute the Inverse DTFT of the following. Use the discrete-time transform tables on the course website.

(a) $X(\omega) = \pi \sum_{k=-\infty}^{\infty} [\delta(\omega - \pi/3 - 2\pi k) + \delta(\omega + \pi/3 - 2\pi k)]$

(b) $X(\omega) = \dfrac{3}{1 + (1/2)e^{-j\omega}}$

(c) $X(\omega) = \dfrac{e^{-j\omega 4}}{5 - e^{-j\omega}}$

(d) $X(\omega) = \cos(\omega n_0) - j\sin(\omega n_0)$, where n_0 is a real, scalar value.