Problem Solving Session XV
ENGR 3302: Signals and Systems

NOTE: Please, complete the following table and keep record of your assignment number.

| First Name |  |
| Last Name |  |
| Student ID |  |
| Assignment # | 0 |

Exercise 1. Consider a discrete-time LTI system with unit impulse response $h[n] = u[n]$, where $u[n]$ is the causal unit step function. Let $x[n]$ and $y[n]$ be the input and output signal, respectively. Let $x[n] = n u[n]$.

A) Derive the $z$-transform of $y[n]$ [pt. 15].

B) Derive the expression for $y[n]$ [pt. 15].

Exercise 2. Consider a discrete-time LTI system with unit impulse response $h[n] = \delta[n-1] - \delta[n-2]$, where $\delta[n]$ is the unit impulse function. Let $x[n]$ and $y[n]$ be the input and output signal, respectively. Let the $z$-transform of $x[n]$ be

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

A) Derive the $z$-transform of $y[n]$ [pt. 15].

B) Derive, sketch and label carefully $y[n]$ [pt. 15].

Exercise 3. Consider a discrete-time LTI system with unit impulse response $h[n] = \delta[n] - \delta[n-1]$, where $\delta[n]$ is the unit impulse function. Let $x[n]$ and $y[n]$ be the input and output signal, respectively. Let the $z$-transform of $x[n]$ be

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

A) Derive the $z$-transform of $y[n]$ [pt. 15].

B) Derive, sketch and label carefully $y[n]$ [pt. 15].

Exercise 4. Consider a discrete-time LTI system with unit impulse response $h[n] = u[n]$, where $u[n]$ is the causal unit step function. Let $x[n]$ and $y[n]$ be the input and output signal, respectively. Let the $z$-transform of $x[n]$ be

$$X(z) = \frac{z - 1}{z + 1/2} \quad |z| > 1/2$$

A) Derive the $z$-transform of $y[n]$ [pt. 15].

B) Derive, sketch and label carefully $y[n]$ [pt. 15].

Exercise 5. Consider a discrete-time LTI system with unit impulse response $h[n]$. Let $x[n]$ and $y[n]$ be the input and output signal, respectively. Let the $z$-transform of $h[n]$ be

$$H(z) = \frac{1}{1 + z} \quad |z| > 1.$$ 

Let $x[n] = u[n]$, where $u[n]$ is the causal unit step function.
A) Derive the z-transform of $y[n]$ [pt. 10].

B) Derive, sketch and label carefully $y[n]$ [pt. 15].

Exercise 6. A discrete-time signal $x[n]$ has the following z-transform

$$X(z) = \frac{1}{1 + z^{-1}} \quad |z| > 1.$$  

A) Derive the z-transform of $y[n] = x^2[n]$ [pt. 15].