California State University, Sacramento
The College of Engineering and Computer Science

EEE 180 Signals & Systems

Midterm 2

Spring 2023

Student Name: _____

Unilateral Laplace Transform Table

	$f(t)$	$F(s)$
1	$\delta(t)$	1
2	$u(t)$	$\frac{1}{s}$
3	$tu(t)$	$\frac{1}{s^2}$
4	$t^n u(t)$	$\frac{n!}{s^{n+1}}$
5	$e^{\lambda t}u(t)$	$\frac{1}{s-\lambda}$

Unilateral Z-transform Pair Table

	$f[k]$	$F[z]$
1	$\delta[k-j]$	z^{-j}
2	$u[k]$	$\frac{z}{z-1}$
3	$ku[k]$	$\frac{z}{(z-1)^2}$
4	$k^2u[k]$	$\frac{z(z+1)}{(z-1)^3}$
5	$k^3u[k]$	$\frac{z(z^2+4z+1)}{(z-1)^4}$
6	$\gamma^{k-1}u[k-1]$	$\frac{1}{z-\gamma}$
7	$\gamma^k u[k]$	$\frac{z}{z-\gamma}$

1.[25 points]

The discrete system equation and initial conditions are given below:

$$y[k+2]+\frac{3}{2}\,y[k+1]+\frac{1}{2}\,y[k]=0, \qquad y[-1]=-3,\ \ y[-2]=1.$$

Please find the system output response for the above discrete-time system by using the following three steps.

(1). What is the characteristic polynomial equation for the above system?

(2). What are the values of the two roots of the characteristic polynomial equation for this system?

(3). Find the output system response of this discrete time system.

2. [35 points]

(1). Determine the Inverse Laplace transform of $F(s) = \frac{5}{s+3} + \frac{8}{s-4}$ by using the unilateral Laplace transform table.

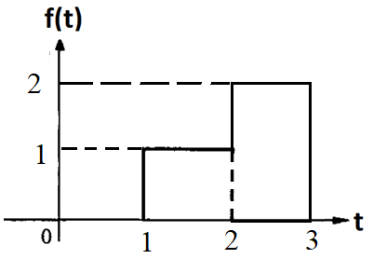
Your solution: f(t) = _____

(2). Determine the Inverse Laplace transform of $F(s) = 2 + \frac{2}{s^2}$ by using the unilateral Laplace transform table.

Your solution: f(t) = _____

(3). Calculate Laplace transform $F(s) = \int_0^{\infty} f(t)\, e^{-st} dt$ of the following signal and find the region of convergence.

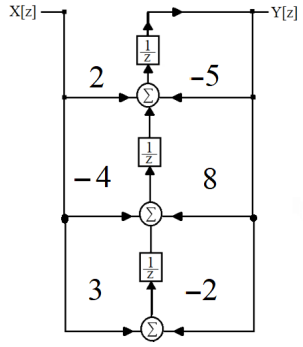
$$f(t) = \begin{cases} 1, & 1 \le t < 2 \\ 2, & 2 \le t < 3 \end{cases} .$$



3. [40 points]

(1). The discrete-time system is described by
y[k+1] + 2y[k] = f[k], with $f[k] = u[k]\ and\ y[0] = 0$.
Solve the above equation iteratively to determine y[1] and y[2] values.

(2). The transformed direct form II structure is shown below.



The system transfer function is:

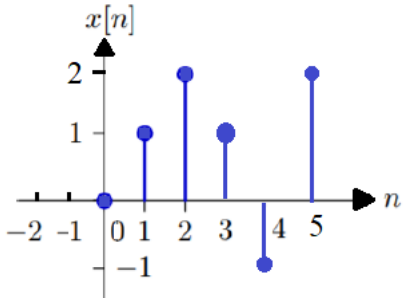
$$H[z] = \frac{Y[z]}{X[z]} = \frac{Az^{-1} + Bz^{-2} + C\,z^{-3}}{D + Ez^{-1} + Fz^{-2} + Gz^{-3}}$$

According to the structure on the left,

A=_____, B= _____, C = _____, D=_____

E=_____, F=_____, G=_____.

(3). Find the z-transform for the following discrete-time signal.



(4). Find the inverse z-transform of the following function with ROC: |z| > 4.

$$F[z] = \frac{z(z-3)}{z^2 - 6z + 8}$$