DSA-Assignment-3

Deadline: 13th February 2025

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1. Solve all the question and submit a handwritten document
2. Plagiarism will be penalised
3. Submit a pdf of the form <**roll_no**>_**dsa3.pdf**

LTI Analysis

1. Determine the output $y[n]$ of a relaxed LTI system with impulse response $h[n] = a^n \cdot u[n]$, $|a| < 1$, and when the input is a unit step sequence, i.e., $x[n] = u[n]$.

2. Obtain and sketch the impulse response of the shift-invariant system given below:

$$y[n] = 0.3x[n] + 0.4x[n-1] - 0.1x[n-3] + 0.2x[n-4]$$

3. A digital system is described by the following difference equation:

$$y[n] = 2x[n] - 0.7x[n-1] + 0.25x[n-2]$$

Find the transfer function $H(z)$, denominator polynomial $A(z)$ and numerator polynomial $B(z)$.

Z-Transform

1. Consider two sequences:

$$x_1(n) = 5\delta(n) + 3\delta(n-1)$$
$$x_2(n) = 3\delta(n) - 2\delta(n-1)$$

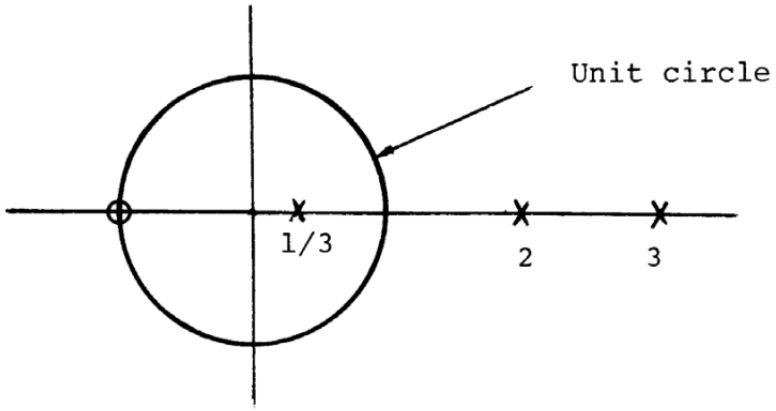
(a) Find the z-transform of the convolution:

$$X(Z) = Z(x_1(n) * x_2(n))$$

(b) Determine the convolution sum using the z-transform:

$$x(n) = x_1(n) * x_2(n) = \sum_{k=0}^{\infty} x_1(k)x_2(n-k)$$

2. The pole-zero Plot of a system is as shown below:



(a) If the system function $H(z)$ is known to converge for $|z| = 1$, find the ROC and state if $h[n]$ is left/right/double-sided.

(b) It is unknown if $H(z)$ converges for $|z| = 1$. How many different ROCs are possible in this case? Pick one, if any, that results in:

(i) a stable and causal system,

(ii) a stable but not causal system, and

(iii) a causal but unstable system.

3. Compute the Z-transform for the given signals and specify the corresponding ROC:

(a) $x(n) = b^n \cdot u(n-1) + a^n \cdot u(-n)$

(b) $x(n) = \{1, 0, 2, \underset{\uparrow}{5}, 7, 4\}$