DSA-Assignment-3

Deadline: 14th April 2024

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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**

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1 Z-Transform

1. Find the z-transform for the following and also mention the ROC:
   1. $x(n) = \{2, 4, \underset{\uparrow}{5}, 7, 0, 1\}$
   2. $x(n) = a \cdot u(n) + b \cdot u(-n-1)$
2. Consider two sequences:

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

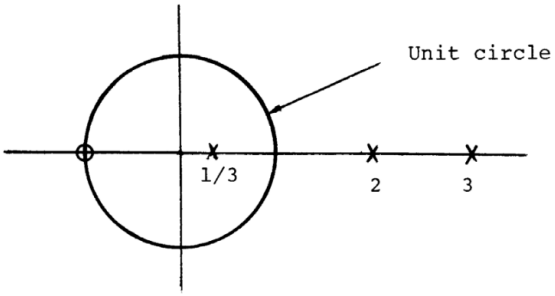
   1. Find the z-transform of the convolution:

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

   2. Determine the convolution sum using the z-transform:

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

3. The pole-zero Plot of a system is as shown below:
   1. 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.
   2. 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.



2 LTI Analysis: Z-Transform

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:

$$y[n] = 0.1x[n] + 0.2x[n-1] + 0.3x[n-2] + 0.4x[n-4]$$

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

$$y[n] = x[n] - 0.5x[n-1] + 0.36x[n-2]$$

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