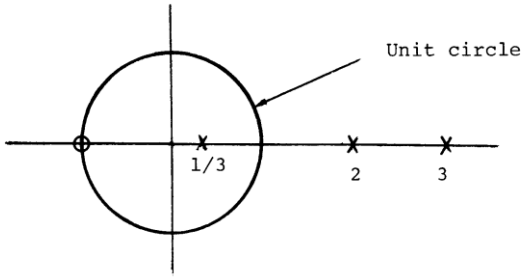
Signal Processing **Assignment- 3** Monsoon 2023

1. If $X(z) = \frac{1}{1+0.5z^{-1}}$; $|z| \geq 0.5$, then find the Z-transform of the following signals.
   a. $y_1[n] = x[3-n] + x[n-3]$
   b. $y_2[n] = (\frac{1}{2})^n x[n-2]$
   c. $y_4[n] = x[n-2] * x[2-n]$
   d. Derive the Z-transform of $n\,x[n]$ and use it to find the Z-transform of the signal $y_3[n] = (1+n+n^2)x[n]$, where X(z) is as given above.

2. A signal $x[n] = (\frac{1}{2})^n u[n]$ has a Z-transform X(z). Then find the signals with the following Z-transforms.
   a. $Y_1(z) = z\,X(\frac{1}{z})$
   b. $Y_2(z) = (\frac{z-1}{z})X(z)$
   c. $Y_3(z) = X(z)\,X(\frac{1}{z})$
   d. $Y_1(z) = z^2 \frac{dX(z)}{dz}$

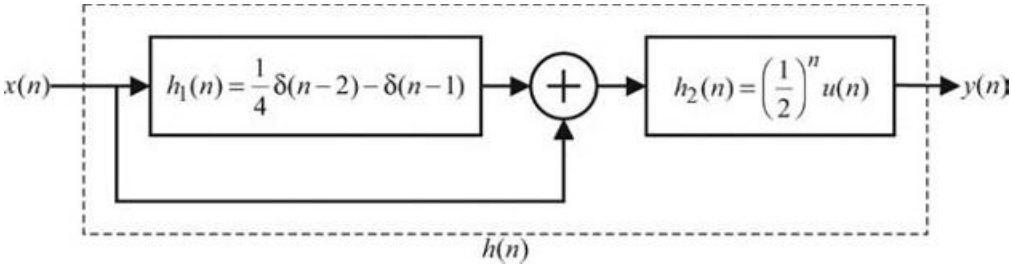
3. $X(z)$ has a zero at origin, and poles at $z = 3\ and\ \frac{1}{3}$. If x[n] is known to be a double-sided signal find X(z), its ROC, and its inverse x[n]. Can you generalize this result?

4. The pole -zero locations 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 and (iii) a causal but unstable system.

5. The block diagram of a system is given below.



a. Find the impulse response h[n] for the overall system using Z-transforms.
b. Locate the poles and zeros of H(z) and based on their location state if this system is stable and / or causal.
c. What is the signal processing function performed by this system?