Gate Assignment 1

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Download the python codes from:

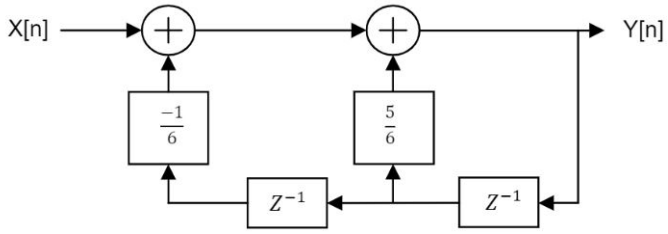
https://github.com/tanayyadav28/EE3900–Assignments/blob/main/GateAssignment_1/code/GateAssignment_1.py

Download the latex-tikz codes from:

https://github.com/tanayyadav28/EE3900–Assignments/blob/main/GateAssignment_1/code/GateAssignment_1.tex

1 Problem

[Gate EC 2015; Q44]
For the discrete-time system shown in the figure, the poles of the system transfer function are located at:



1) $2, 3$
2) $\frac{1}{2}, 3$
3) $\frac{1}{2}, \frac{1}{3}$
4) $2, \frac{1}{3}$

2 Solution

The difference equation of the given discrete-time system is :

$$y[n] = x[n] - \frac{1}{6}y[n-2] + \frac{5}{6}y[n-1] \tag{2.0.1}$$

$$\therefore x[n] = y[n] - \frac{5}{6}y[n-1] + \frac{1}{6}y[n-2] \tag{2.0.2}$$

Applying z-transform to (2.0.2),

$$X[z] = Y[z]\left(1 - \frac{5}{6}Z^{-1} + \frac{1}{6}Z^{-2}\right) \tag{2.0.3}$$

The system transfer function $H(z)$ is given as:

$$H(z) = \frac{Y(z)}{X(z)} \tag{2.0.4}$$

$$H(z) = \frac{1}{1 - \frac{5}{6}Z^{-1} + \frac{1}{6}Z^{-2}} \tag{2.0.5}$$

$$= \frac{Z^2}{Z^2 - \frac{5}{6}Z^1 + \frac{1}{6}} \tag{2.0.6}$$

$$= \frac{Z^2}{(Z - \frac{1}{2})(Z - \frac{1}{3})} \tag{2.0.7}$$

The poles can be found by solving the denominator:

$$\left(Z - \frac{1}{2}\right)\left(Z - \frac{1}{3}\right) = 0 \tag{2.0.8}$$

Therefore, the poles of the system transfer function are located at $\frac{1}{2}$ and $\frac{1}{3}$ (Option 3).