

LINEAR SYSTEMS AND SIGNAL PROCESSING

GATE ASSIGNMENT 4

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Download latex codes from

https://github.com/VARSHITHAGANJI/EE3900_GATE_ASSIGNMENTS/blob/main/GATE_ASSIGNMENT4/GATE_ASSIGNMENT4.tex

Download all python codes from

https://github.com/VARSHITHAGANJI/EE3900_GATE_ASSIGNMENTS/blob/main/GATE_ASSIGNMENT4/code.py

Hence the roots are 0,0.9,-0.9.

QUESTION

GATE EC-1992 Question 1.8

A linear discrete - time system has the characteristic equation, $z^3 - 0.81z = 0$. The system

- 1) is stable
- 2) is marginally stable
- 3) is unstable
- 4) stability cannot be assessed from the given information

SOLUTION

Definition 1. We say that an initially relaxed (all the initial conditions of the system are zero) LTI system is **stable** if it produces a bounded output for every possible bounded input, i.e it satisfies the BIBO(Bounded-input-Bounded-output) condition.

Lemma 0.1. For the system to be stable, the roots of the characteristic equation must lie within the unit circle in z -plane.

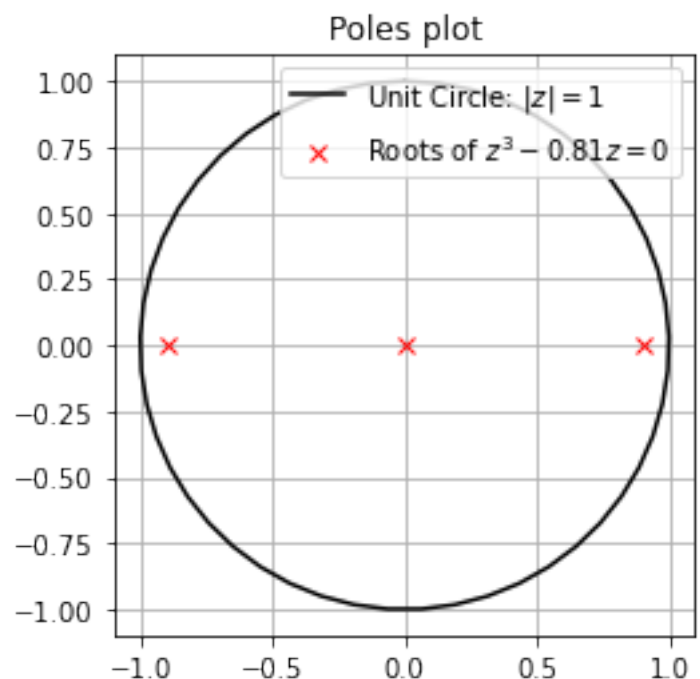
Finding the roots of the given characteristic equation,

$$z^3 - 0.81z = 0 \quad (0.0.1)$$

$$z(z^2 - 0.81) = 0 \quad (0.0.2)$$

$$z((z + 0.9)(z - 0.9)) = 0 \quad (0.0.3)$$

$$(0.0.4)$$



Since the roots lie inside the unit circle we say that the system is stable.

\therefore Option 1 is correct.