
SIGNAL PROCESSING

Through GATE

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Introduction

This book provides solutions to signal processing problems in GATE.

Chapter 1

Harmonics

Chapter 2

Filters

Chapter 3

Z-transform

Chapter 4

Sequences

4.1 Consider the discrete time signal $x[n] = u[-n + 5] - u[n + 3]$, where

$$u[n] = \begin{cases} 1; n \geq 0 \\ 0; n < 0 \end{cases}$$

The smallest n for which $x[n] = 0$ is?

Solution: From Fig. 1, the minimum value of n is given as

$$n = -3 \tag{4.1}$$



Figure 1: Plot of function $x(n)$ taken from python3

Chapter 5

Contour Integration

Chapter 6

Laplace Transform

6.1 The number of zeroes of the polynomial $P(s) = s^3 + 2s^2 + 5s + 80$ in the right side of the plane? (GATE IN 2023)

Solution: The table below shows the Routh array of the n^{th} - order characteristic polynomial :

$$a_0s^n + a_1s^{n-1} + \dots + a_{n-1}s^1 + a_ns^0 \quad (6.1)$$

s^n	a_0	a_2	a_4	...
s^{n-1}	a_1	a_3	a_5	...
s^{n-2}	$b_1 = \frac{a_1a_2 - a_3a_0}{a_1}$	$b_2 = \frac{a_1a_4 - a_5a_0}{a_1}$
s^{n-3}	$c_1 = \frac{b_1a_3 - b_2a_1}{b_1}$	\vdots		
\vdots	\vdots	\vdots		
s^1	\vdots	\vdots		
s^0	a_n			

Table 6.1: Routh Array

Characteristic Equation:

$$s^3 + 2s^2 + 5s + 80 = 0 \quad (6.2)$$

From Table 6.1:

s^3	1	5
s^2	2	80
s^1	$\frac{2 \times 5 - 80 \times 1}{2} = -35$	
s^0	$\frac{-35 \times 80}{-35} = 80$	

Table 6.2:

From Table 6.2:

Since there are 2 sign changes in the first column of the Routh tabulation. So, the number of zeros in the right half of the s-plane will be 2.

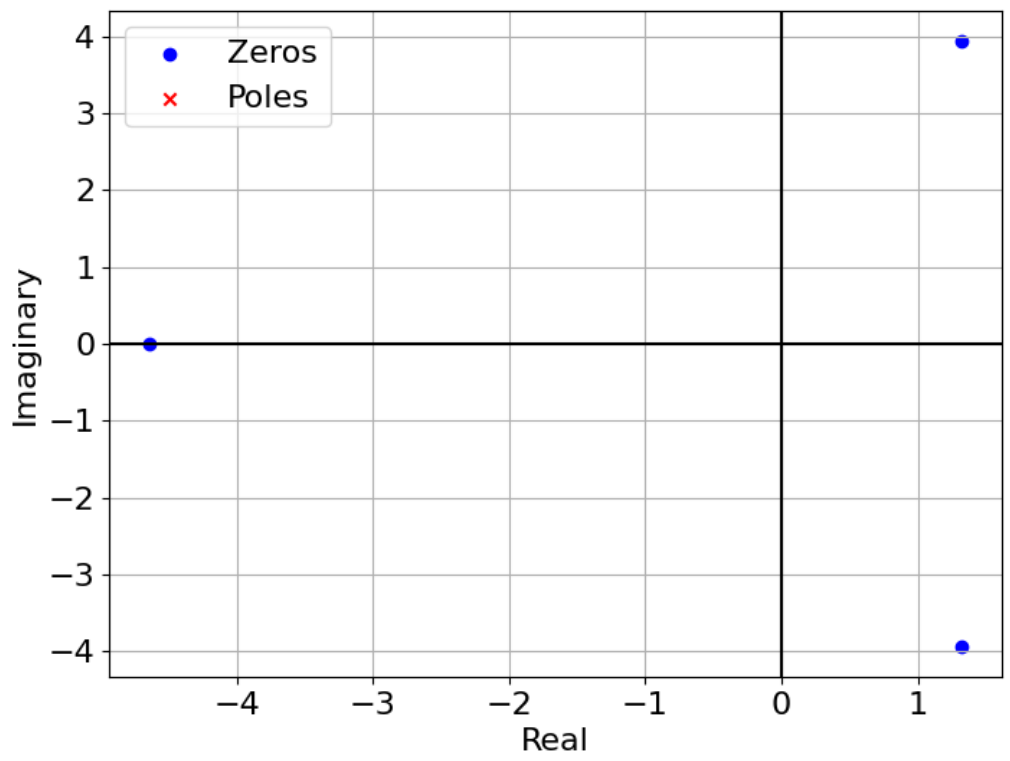


Figure 6.1:

