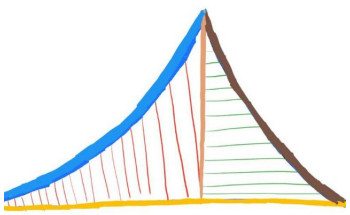
SIGNAL PROCESSING

Through GATE

G. V. V. Sharma



Contents

Introduction

This book provides solutions to signal processing problems in GATE.

Chapter 1

Harmonics

Chapter 2

Filters

Chapter 3

Z-transform

Chapter 4

Sequences

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 :

$$a_0 s^n + a_1 s^{n-1} ..... + a_{n-1} s^1 + a_n s^0 \tag{6.1}$$

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

Table 6.1: Routh Array

Characteristic Equation:

$$s^3 + 2s^2 + 5s + 80 = 0 \tag{6.2}$$

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.

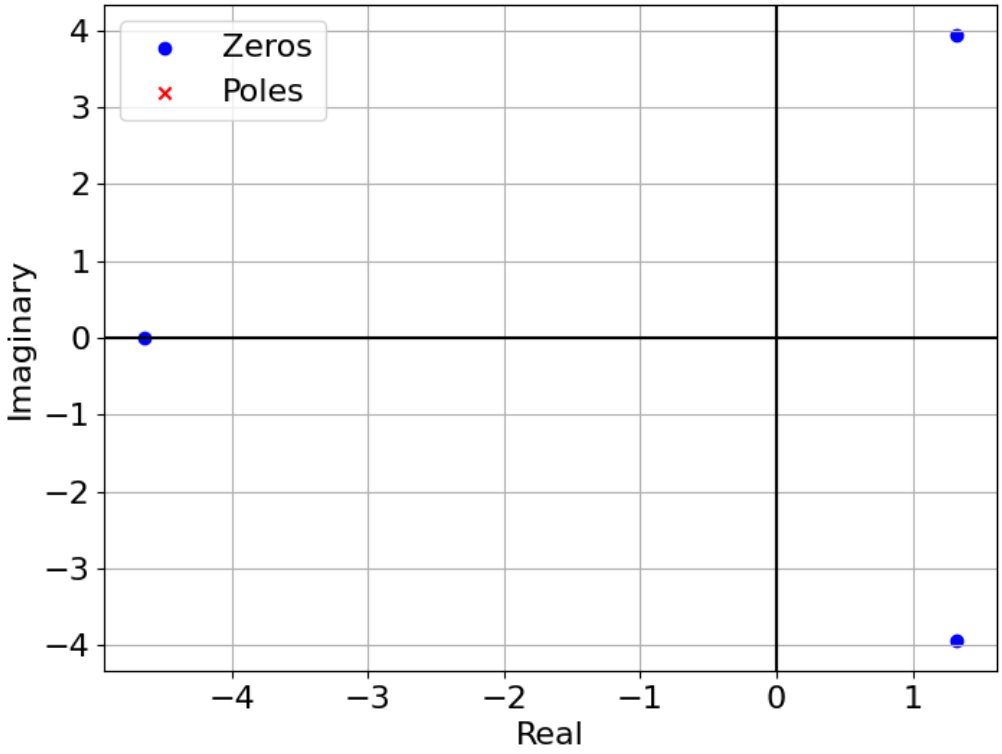


Figure 6.1: