EE 310 - LAB 5

Question:

Consider the following transfer functions:

$$G_1(s) = \frac{s^2+1}{s^5+16s^4+6s^3+80s^2+3s+16}$$

$$G_2(s) = \frac{(s-4)^2}{s^2+4s+3}$$

$$G_3(s) = \frac{s+3}{s^2+3s-4}$$

$$G_4(s) = \frac{s^2(s+1)}{s^2+2s+2}$$

a) Determine the relative degree of each trabsfer function. State which transfer function is strictly proper, proper, improper.
b) Determine which of the transfer functions is BIBO stable. Use the Routh-Hurwitz test if required.
c) Confirm your result in b) by simulating their step response.

Hint:

Stability Test: Routh-Array

Construction

s^n	a_n	a_{n-2}	a_{n-4}	a_{n-6}	$\cdots$
s^{n-1}	a_{n-1}	a_{n-3}	a_{n-5}	a_{n-7}	$\cdots$
s^{n-2}	b_1	b_2	b_3	$\cdots$	$\cdots$
s^{n-3}	c_1	c_2	c_3	$\cdots$	$\cdots$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\ldots$
s^1	w_1	0	0	0	$\cdots$
s^0	z_1	0	0	0	$\cdots$

Coefficients

- $b_1 = \frac{a_{n-1}a_{n-2} - a_n a_{n-3}}{a_{n-1}}$
- $b_2 = \frac{a_{n-1}a_{n-4} - a_n a_{n-5}}{a_{n-1}}$
- $b_3 = \frac{a_{n-1}a_{n-6} - a_n a_{n-7}}{a_{n-1}}$
- $c_1 = \frac{b_1 a_{n-3} - a_{n-1}b_2}{b_1}$
- $c_2 = \frac{b_1 a_{n-5} - a_{n-1}b3}{b_1}$
- $c_3 = \frac{b_1 a_{n-7} - a_{n-1}b_4}{b_1}$
- etc.

Routh/Hurwitz for G_1

S^5	1	6	3
S^4	16	80	16
S^3	1	2	
S^2	48	16	
S^1	80/48	0	
S^0	16		