ECEN 133L Lab 2 Report:

Impulse, Step, and Frequency Response

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Part 1/2 –

Calculated Values:

System 1 xi: 1 0.9 0.81

System 1 xs: 1 1.9 2.71

System 2 xi: 1 -0.9 0.81

System 2 xs: 1 0.1 0.91

Computed Values:

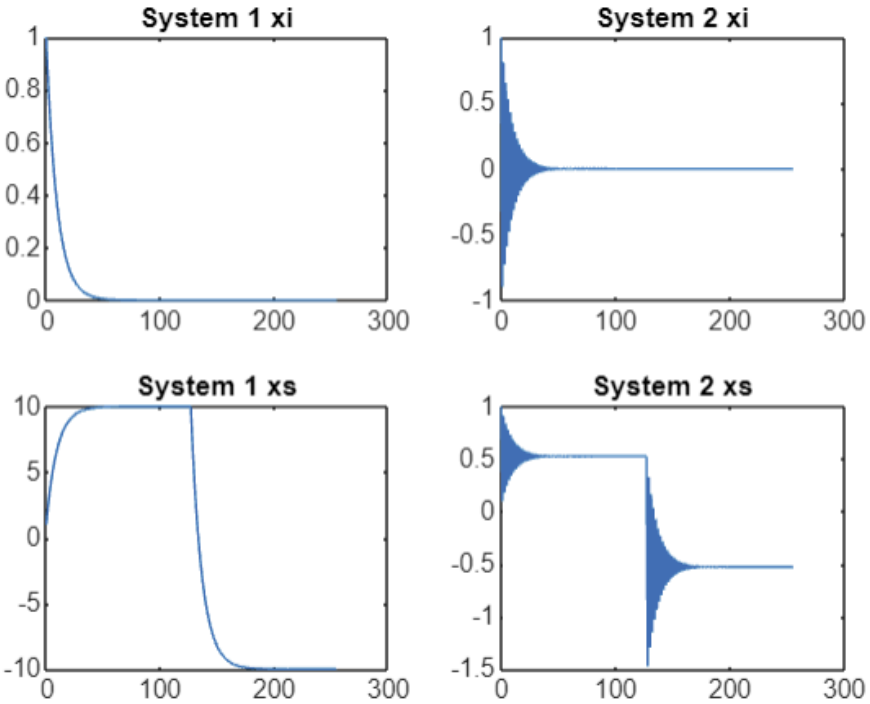
System 1 xi: 1.0000 0.9000 0.8100

System 1 xs: 1.0000 1.9000 2.7100

System 2 xi: 1.0000 -0.9000 0.8100

System 2 xs: 1.0000 0.1000 0.9100

Our calculated values were virtually the same as the ones that we computed with MATLAB



At what index value does the impulse response appear to go to zero on the plot for System 1? For System 2?

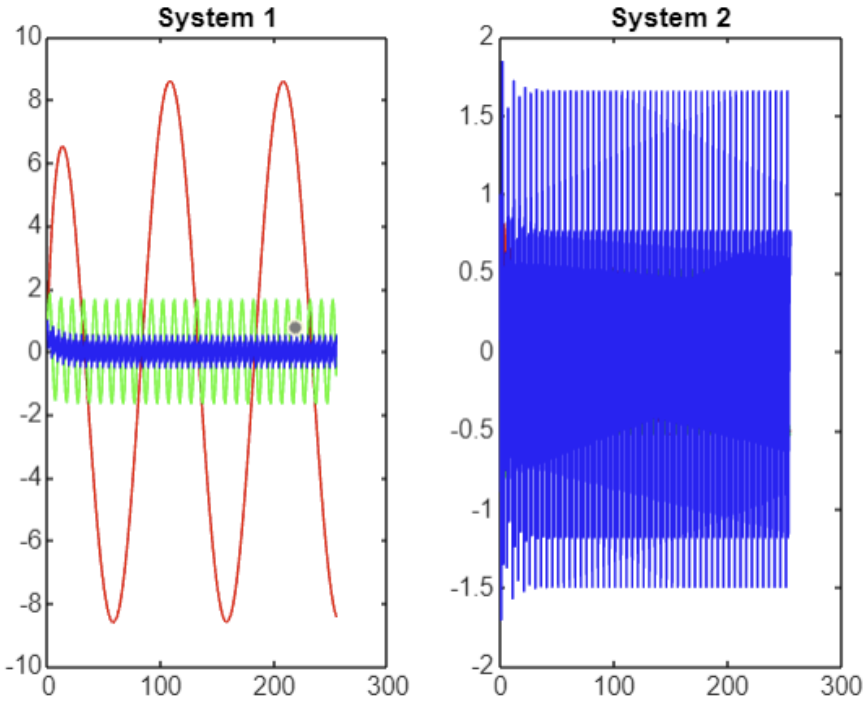
For both systems the impulse response appears to go to zero at around X = 50

Click on the plot to show options above and select the ”+” to zoom in. Use the cursor to select a flat region of each square wave response and determine the value for each system after the transient response is over. How is this value related to the a vector values?

In system 1, it converges to 0

In system 2, the flat region is located at about Y = -0.526 and Y = 0.526

Part 3 -



For each system, find the amplitude of the three responses in the region after the initial transient response has settled.

System 1 - x3 = 8.5, x4 = 1.65, x5 = 0.52

System 2 - x3 = 1.65, x4 = 0.52, x5 = 0.52

Which filter emphasizes low frequencies? Which filter emphasizes high frequencies?

The filter using the coefficients a = [1.0, -0.9] tend to emphasize low frequencies, while the filter using coefficients a = [1.0, 0.9] tend to emphasize higher frequencies

Part 4/5: Repeat with 0.9 → 0.95

Calculated Values:

System 1 xi: 1 0.95 0.903

System 1 xs: 1 1.95 2.85

System 2 xi: 1 -0.95 0.81

System 2 xs: 1 0.05 0.95

Computed Values:

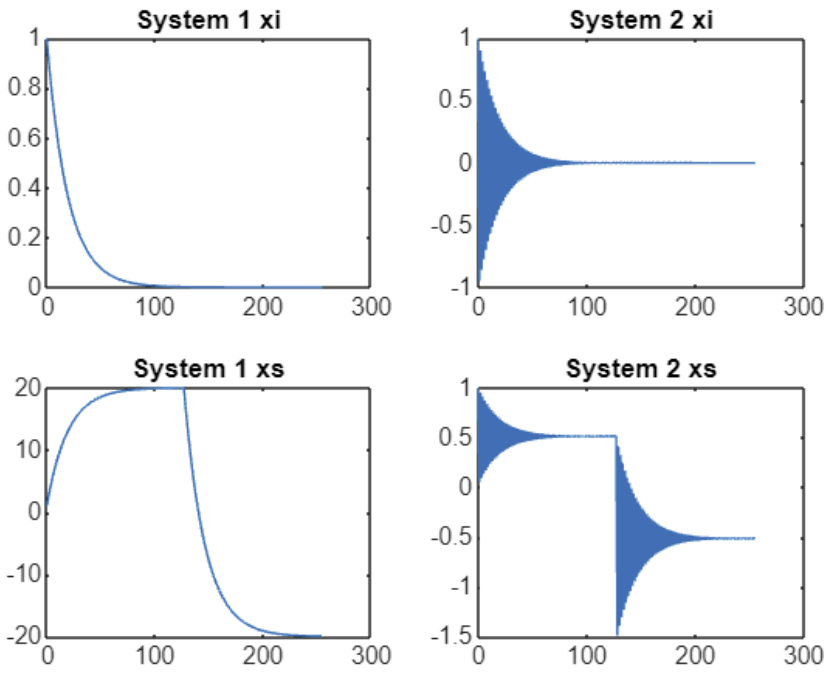
System 1 xi: 1.0000 0.9500 0.9025

System 1 xs: 1.0000 1.9500 2.8525

System 2 xi: 1.0000 -0.9500 0.9025

System 2 xs: 1.0000 0.0500 0.9525

Our calculated values were virtually the same as the ones that we computed with MATLAB



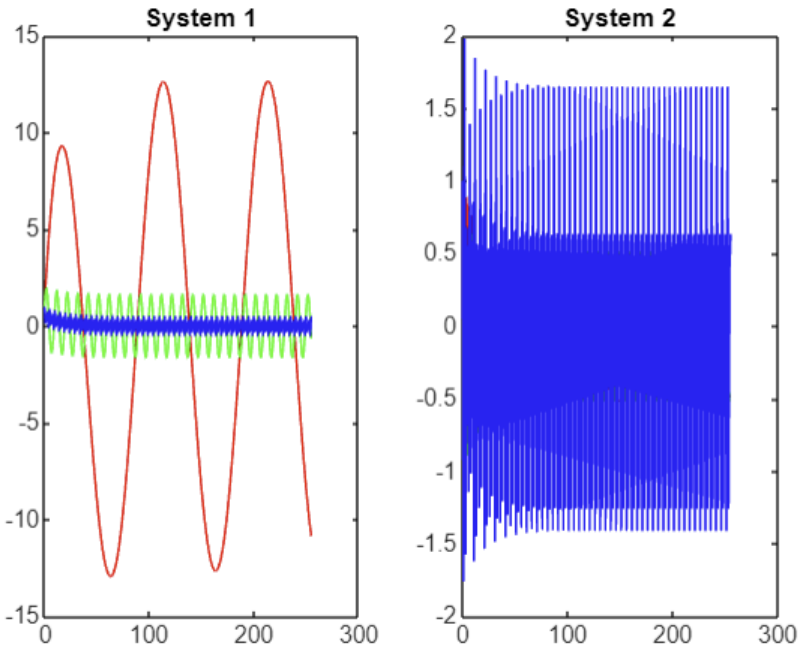
At what index value does the impulse response appear to go to zero on the plot for System 1? For System 2?

For both systems the impulse response appears to go to zero at around X = 100

Click on the plot to show options above and select the ”+” to zoom in. Use the cursor to select a flat region of each square wave response and determine the value for each system after the transient response is over. How is this value related to the a vector values?

In system 1, it converges to 0

In system 2, the flat region is located at about Y = -0.526 and Y = 0.526



For each system, find the amplitude of the three responses in the region after the initial transient response has settled.

System 1 - x3 = 12.6, x4 = 1.67, x5 = 0.52

System 2 - x3 = 1.65, x4 = 0.52, x5 = 0.52

Which filter emphasizes low frequencies? Which filter emphasizes high frequencies?

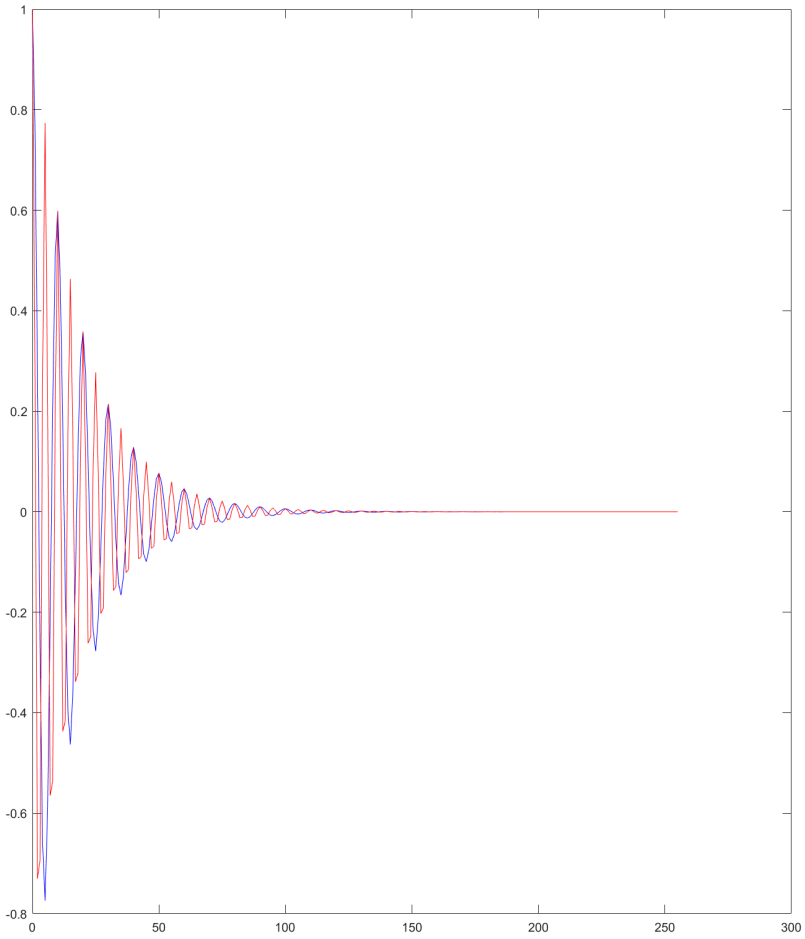
The filter using the coefficients a = [1.0, -0.95] tend to emphasize low frequencies, while the filter using coefficients a = [1.0, 0.95] tend to emphasize higher frequencies

Part 7 -

Compare the impulse responses. How are they similar? How are they different? at what index does the impulse response appear to go to zero on the plot? What is the effect of using 2w compared to w?

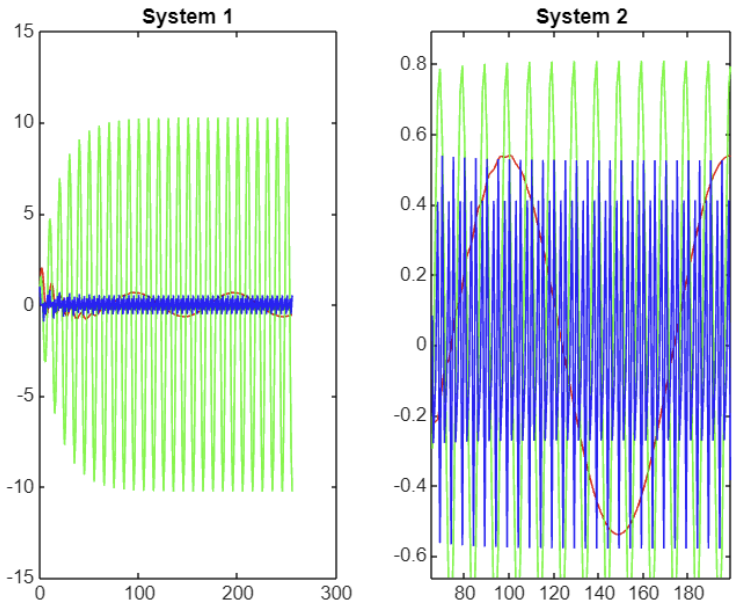
The frequency of the response is doubled and the plot appears to reach zero around index 100.

Compare the step responses:



*Blue - w, Red - w*2*

Part 8 -



How are the frequencies used in the filter specifications related to the frequencies of the three input signals x3, x4, and x5?

The frequencies are being affected differently by the new filter specifications set by a and b based on their different values.

For each system, find the amplitude of the three responses in the region after the initial transient response has settled

System 1 - x3 = 0.65, x4 = 10.2, x5 = 0.52

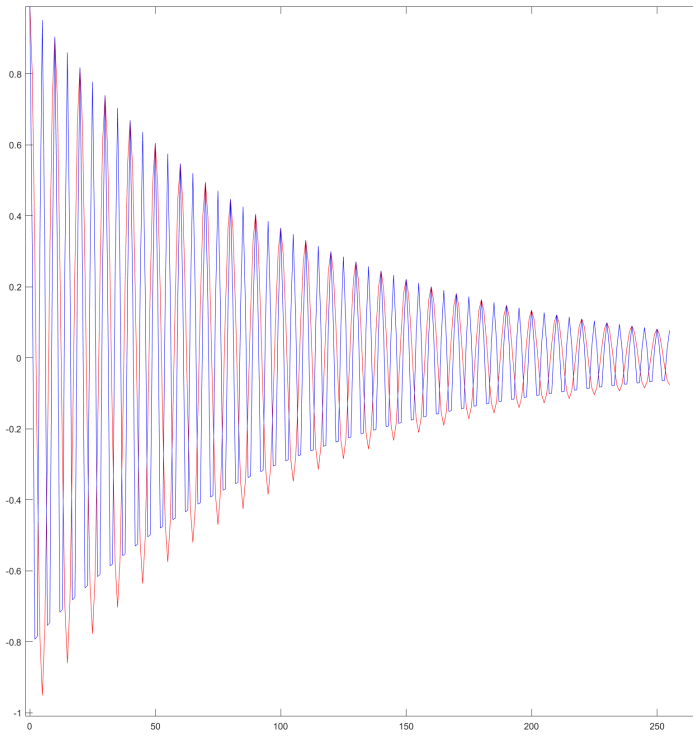
System 2 - x3 = 0.53, x4 = 0.81, x5 = 0.53

Record these values and compare them. For System 1, what is the frequency of the input with the highest amplitude response?

The frequency of the input with the highest amplitude is x4 with a frequency of 0.1

Part 10 -

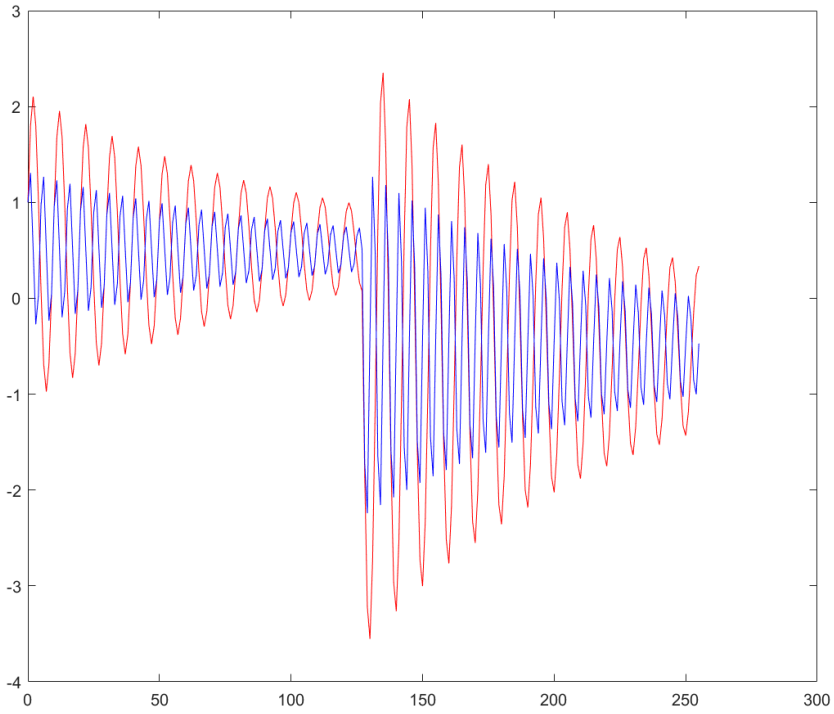
Compare the impulse responses. How are they similar? How are they different? At what index does the impulse response appear to go to zero on the plot? What is the effect of using alpha 2 compared to alpha 1?



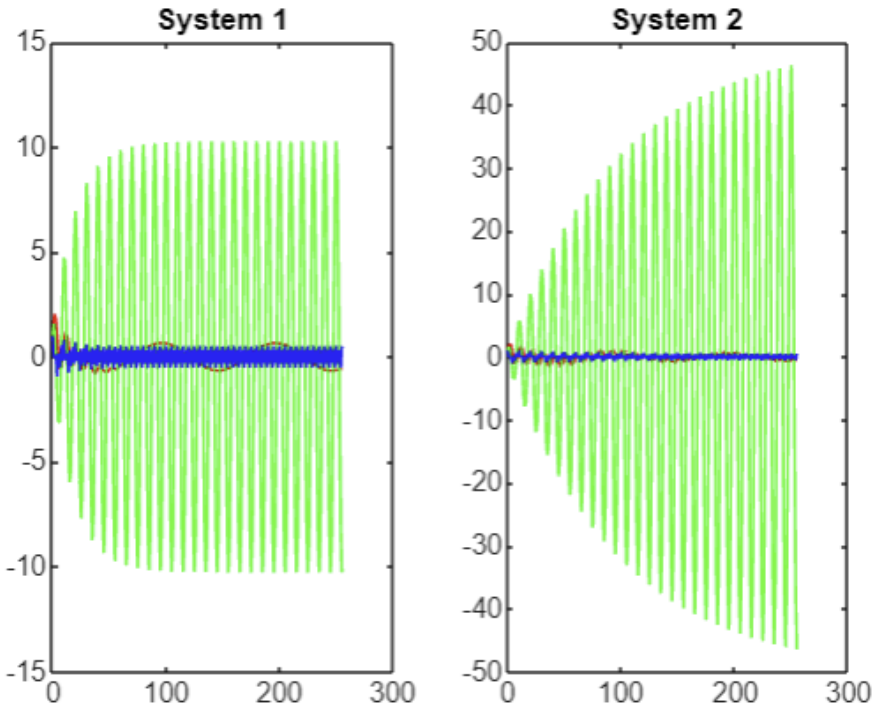
Alpha 2 is causing the wave to oscillate at a lower frequency for a longer period. The plot never reaches zero. When omega is squared the bottom of the wave is being cut off before the minimum points of each period.

Compare the step responses. Is the period of the square wave long enough for the transient response to settle for both systems? How is this related to the impulse Responses?

The period of the square wave is not long enough for the transient response to settle in the same way that the impulse response doesn't. The graph begins shifted up to 0.5 and then shifts down to -0.5 when the square wave goes up to 1.



Part 11 -



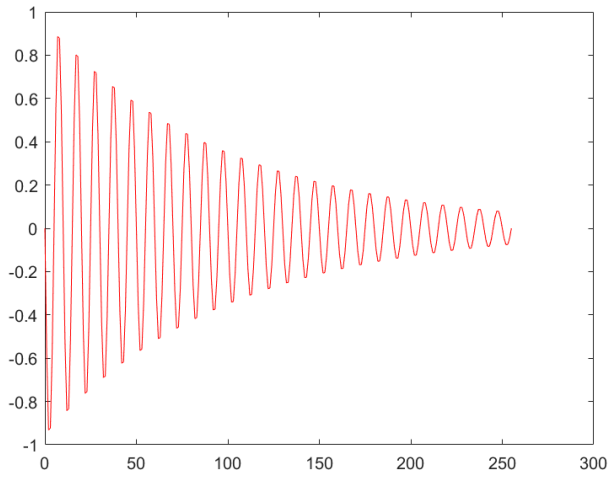
System 1 - x3 = 0.65, x4 = 10.2, x5 = 0.52

System 2 - x3 = 1.2, x4 = 46.26, x5 = 0.65

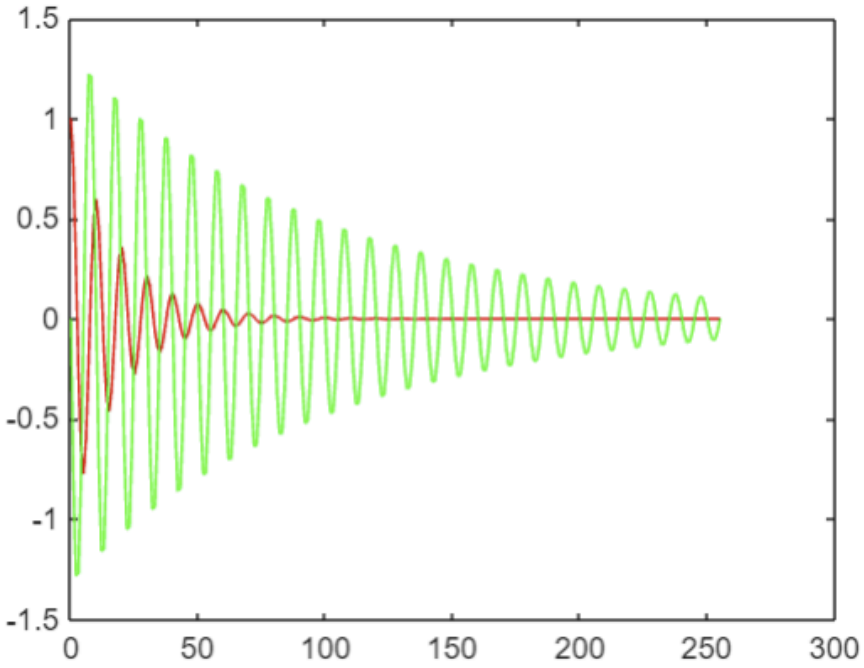
The frequency of the input with the highest amplitude response is x4 with frequency 0.1 for system 1 and system 2.

Part 12 - For System 2, define your system a and b vectors with

a =[1, -2*alpha*cos(w), alpha2] and b =[0, alpha*sin(w)]



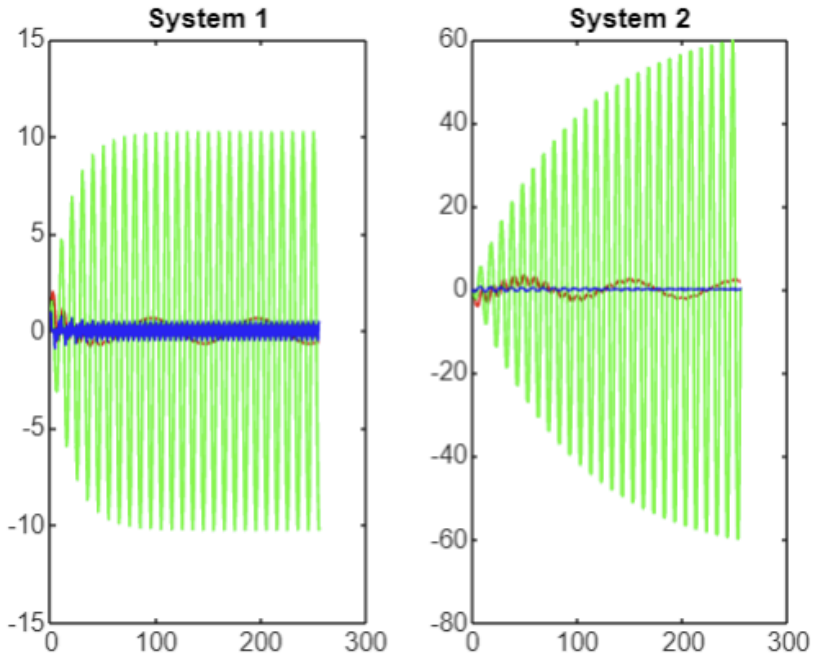
Part 13 -



Compare the impulse responses. How are they similar? How are they different? Look carefully at the first 20 values of the impulse response for each system?

The system 2 impulse response is about double what the system 1 impulse response is.

Part 14 -



System 1 - x3 = 0.65, x4 = 10.2, x5 = 0.52

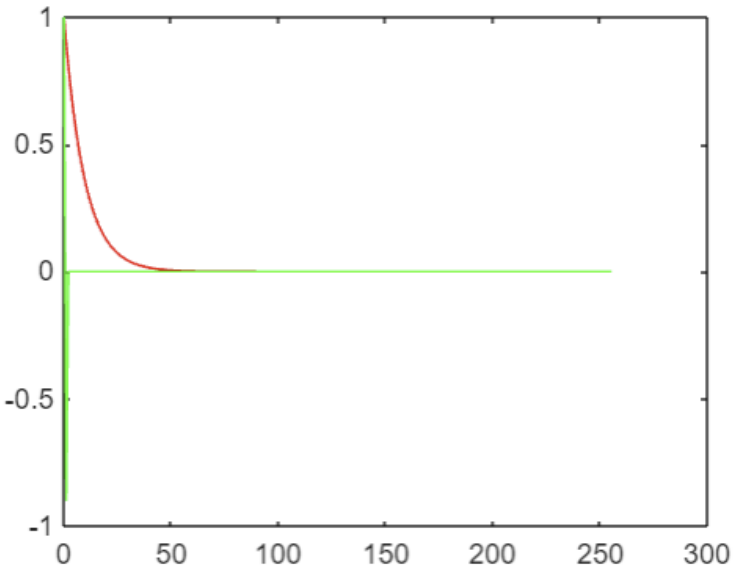
System 2 - x3 = 2.61, x4 = 59.65 , x5 = 0.31

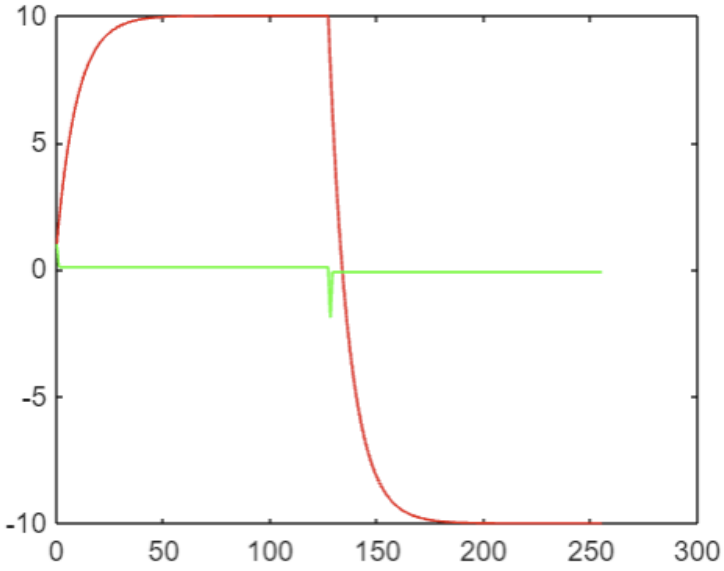
Part 16 -

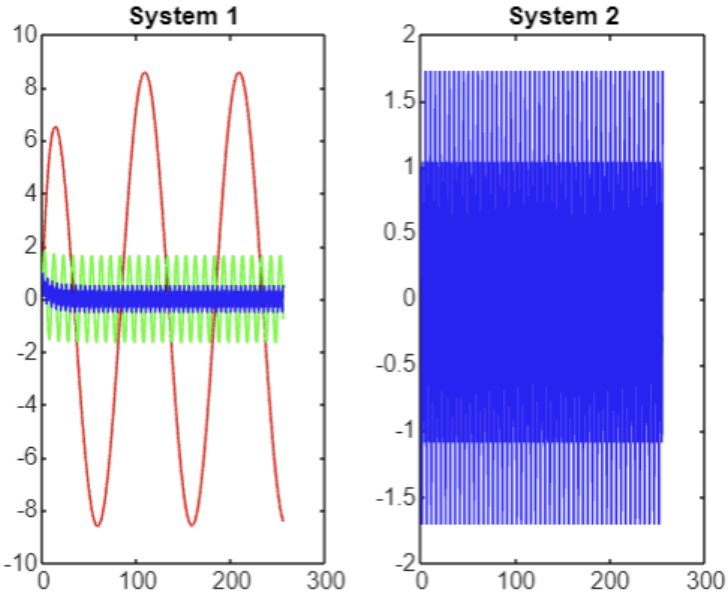
Run sections 3, 4, and 5 and compare impulse and step responses and the responses to x3, x4, and x5

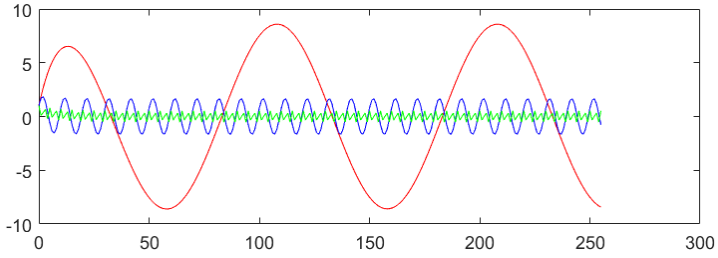
The impulse response shows system 1 starting high and approaching 0, where system 2 almost immediately goes to 0. In the step response, system 1 behaves very similarly to how it did previously, whereas system 2 is reading 0, then spiking low when system 1 starts to go down.

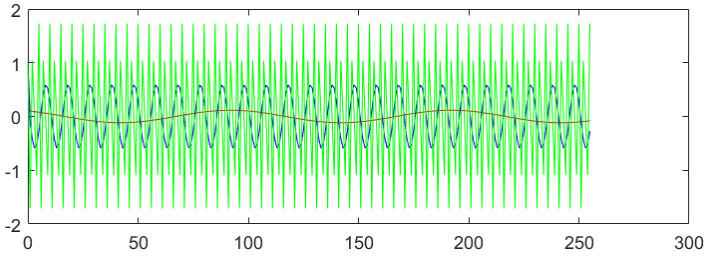
The responses of x3, x4, and x5 look very similar to how they did with the first values of a and b that we had.



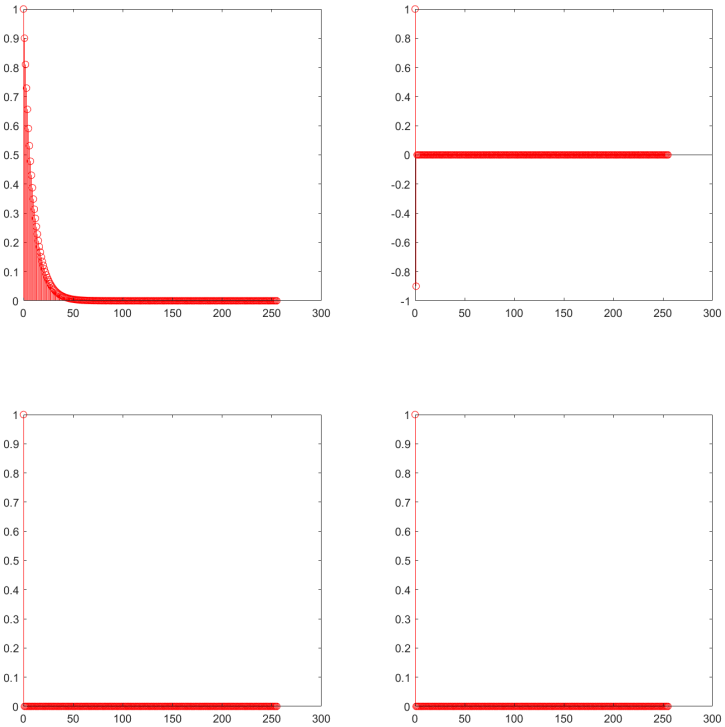



System 1
System 2
10
8
6
4
2
0
-2
-4
-6
-8
-10
0
100
200
300
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2


10
5
0
-5
-10
0
50
100
150
200
250
300


2
1
0
-1
-2
0
50
100
150
200
250
300

Part 17 -


1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0 50 100 150 200 250 300
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0 50 100 150 200 250 300
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0 50 100 150 200 250 300
1
0.9
0.8
0.7
0.6
0.5
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0.2
0.1
0
0 50 100 150 200 250 300