ELEC 4700

Assignment 4

Circuit Modeling

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Question 1

a)

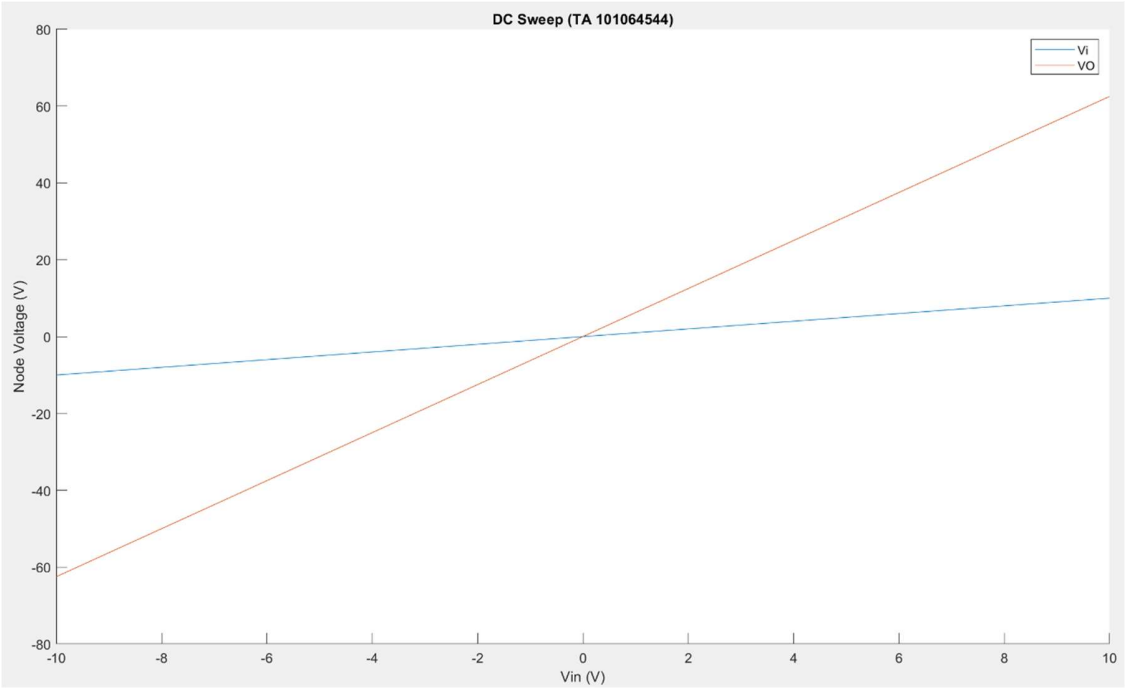
```
Question 1
G matrix

G =

    1.0000   -1.0000         0         0         0         0         0    1.0000
   -1.0000    1.5000         0         0         0    1.0000         0         0
         0         0    0.1000         0         0   -1.0000         0         0
         0         0         0   10.0000  -10.0000         0    1.0000         0
         0         0         0  -10.0000   10.0010         0         0         0
         0    1.0000   -1.0000         0         0         0         0         0
         0         0  -10.0000    1.0000         0         0         0         0
    1.0000         0         0         0         0         0         0         0

C matrix

C =

    0.2500   -0.2500         0         0         0         0         0         0
   -0.2500    0.2500         0         0         0         0         0         0
         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0
         0         0         0         0         0   -0.2000         0         0
         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0
```

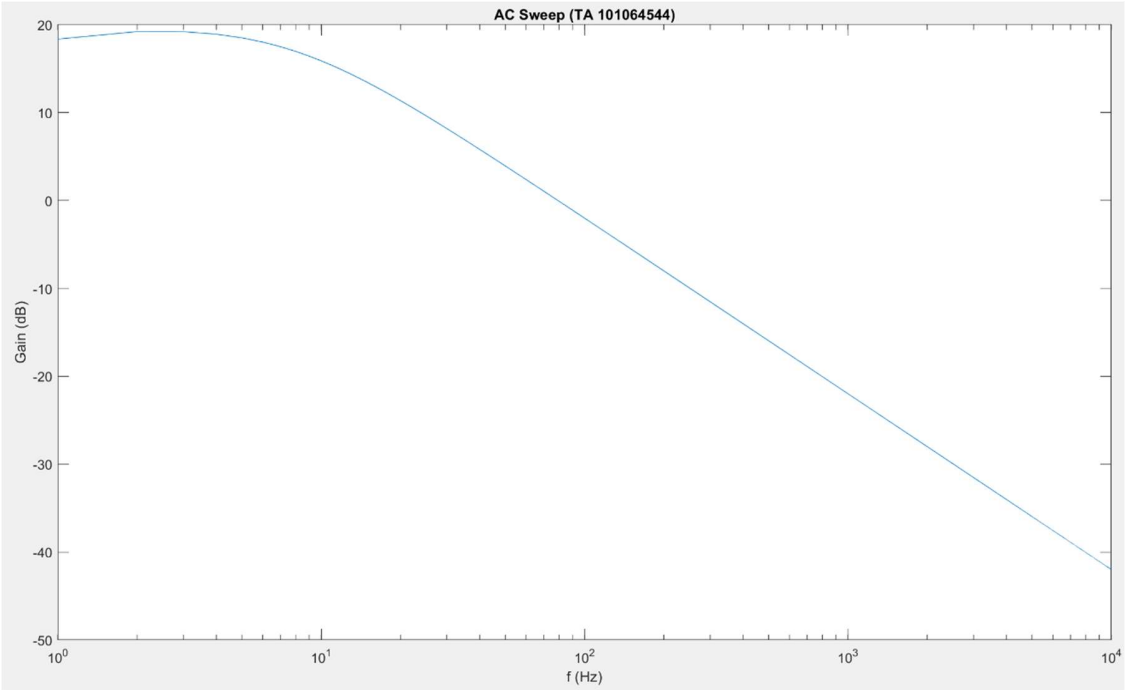
Question 3

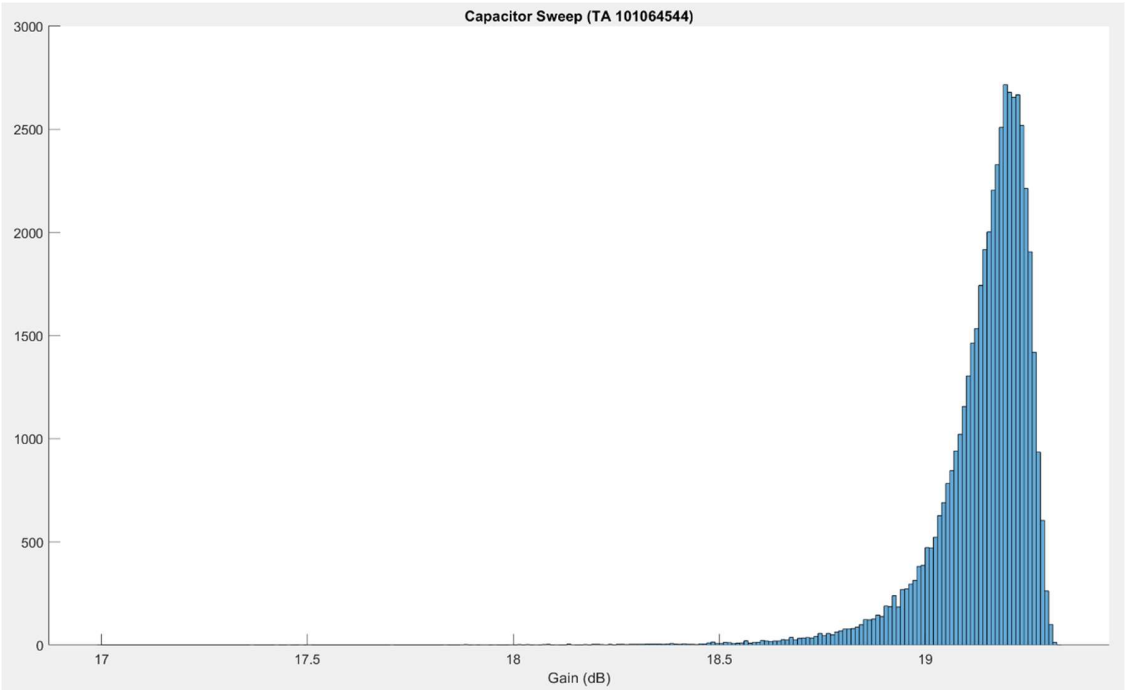
```
Updated C matrix

C =

    0.1736   -0.1736         0         0         0         0         0         0
   -0.1736    0.1736         0         0         0         0         0         0
         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0
         0         0         0         0         0   -0.2000         0         0
         0         0         0         0         0         0         0         0
         0         0         0         0         0         0         0         0
```

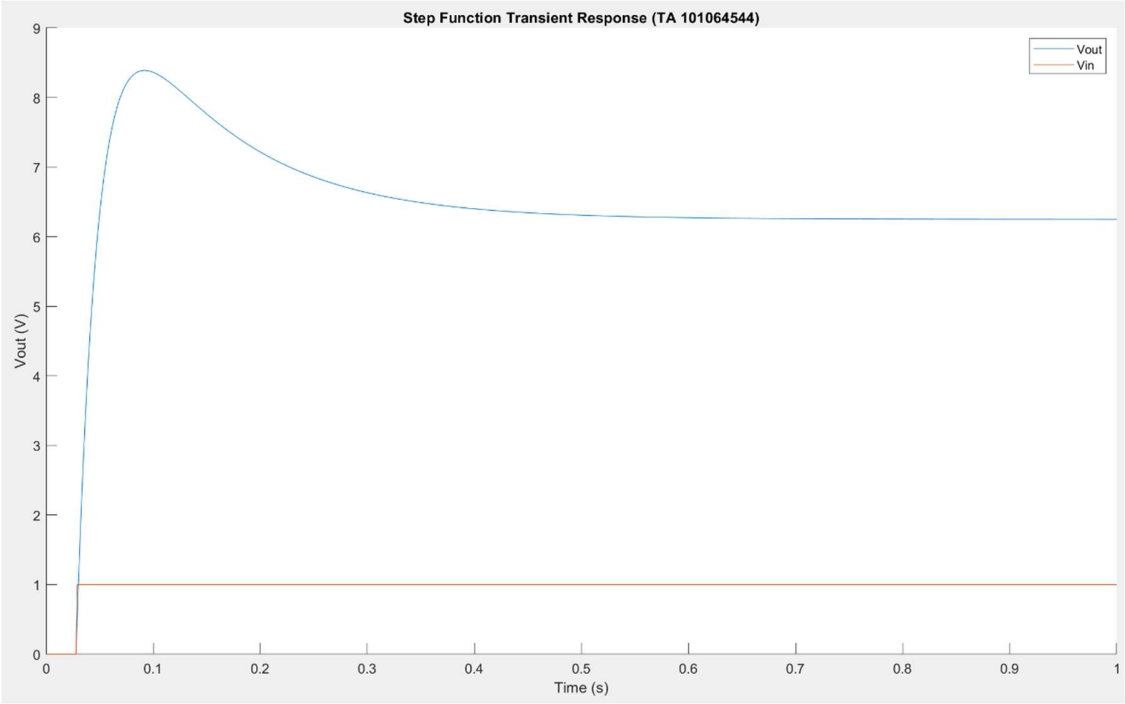
Question 4

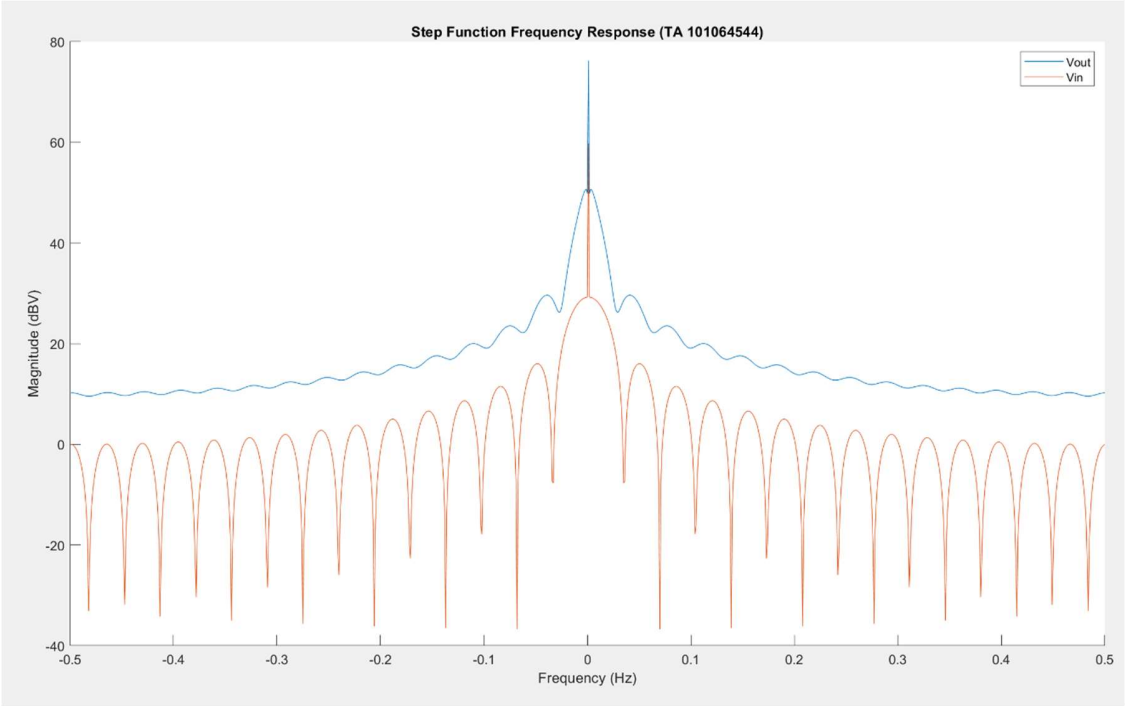
You would need to add another term in the matrix equation to represent the non-linearity. The solution would then be iterative, for the time domain simulation, each step would have to be iteratively solved.

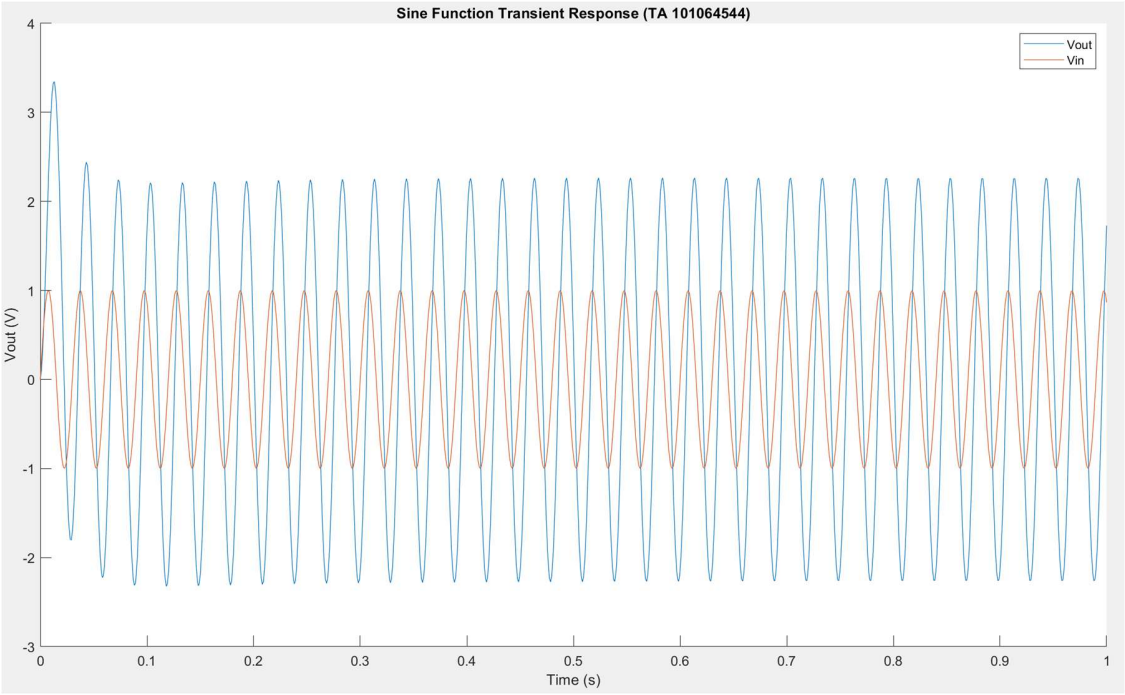

DC Sweep (TA 101064544)
Vi
VO
Node Voltage (V)
Vin (V)
80
60
40
20
0
-20
-40
-60
-80
-10
-8
-6
-4
-2
0
2
4
6
8
10

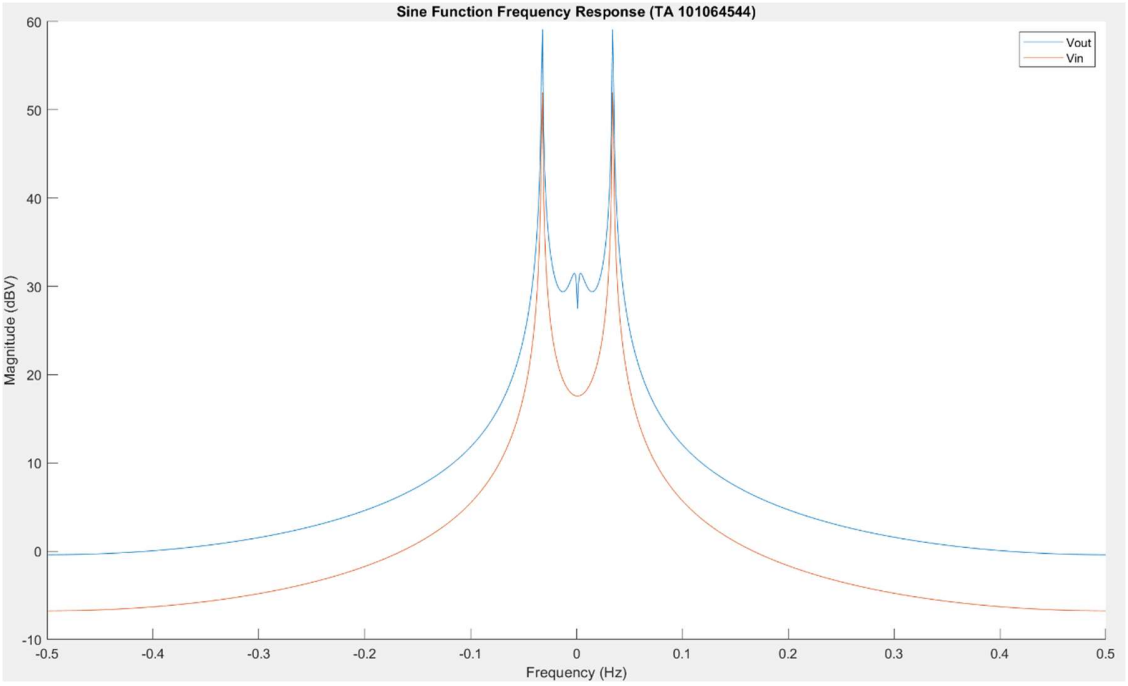

AC Sweep (TA 101064544)
Gain (dB)
f (Hz)
20
10
0
-10
-20
-30
-40
-50
10^0
10^1
10^2
10^3
10^4

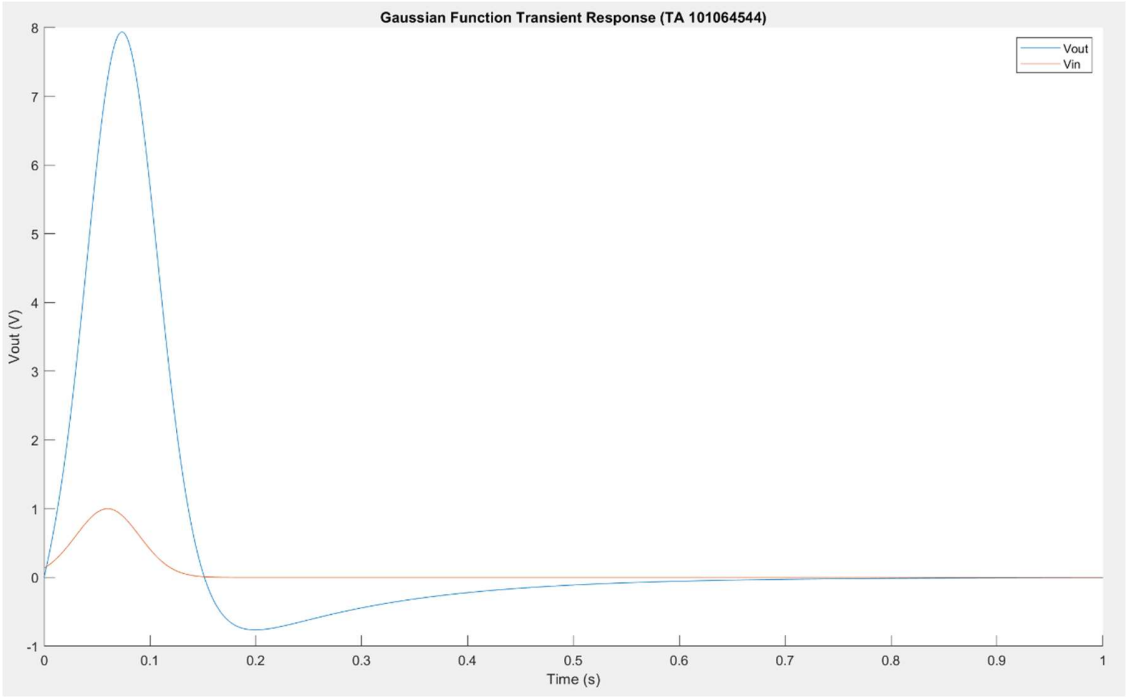

Capacitor Sweep (TA 101064544)
3000
2500
2000
1500
1000
500
0
17
17.5
18
18.5
19
Gain (dB)

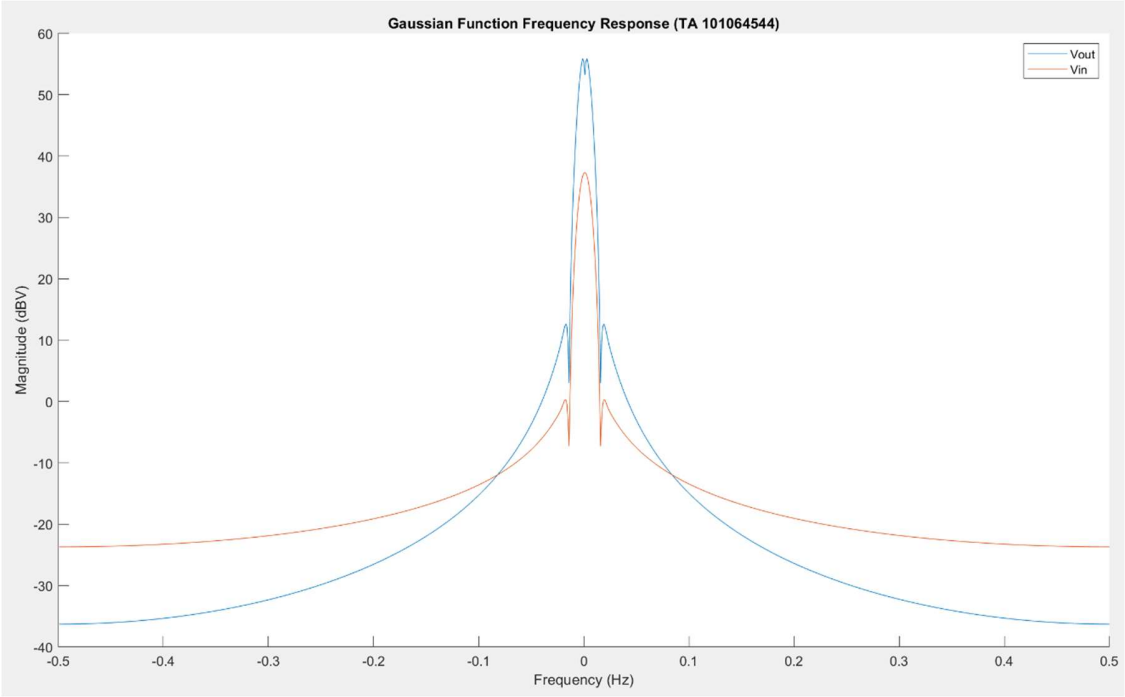

Step Function Transient Response (TA 101064544)
Vout
Vin
Vout (V)
9
8
7
6
5
4
3
2
1
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Time (s)

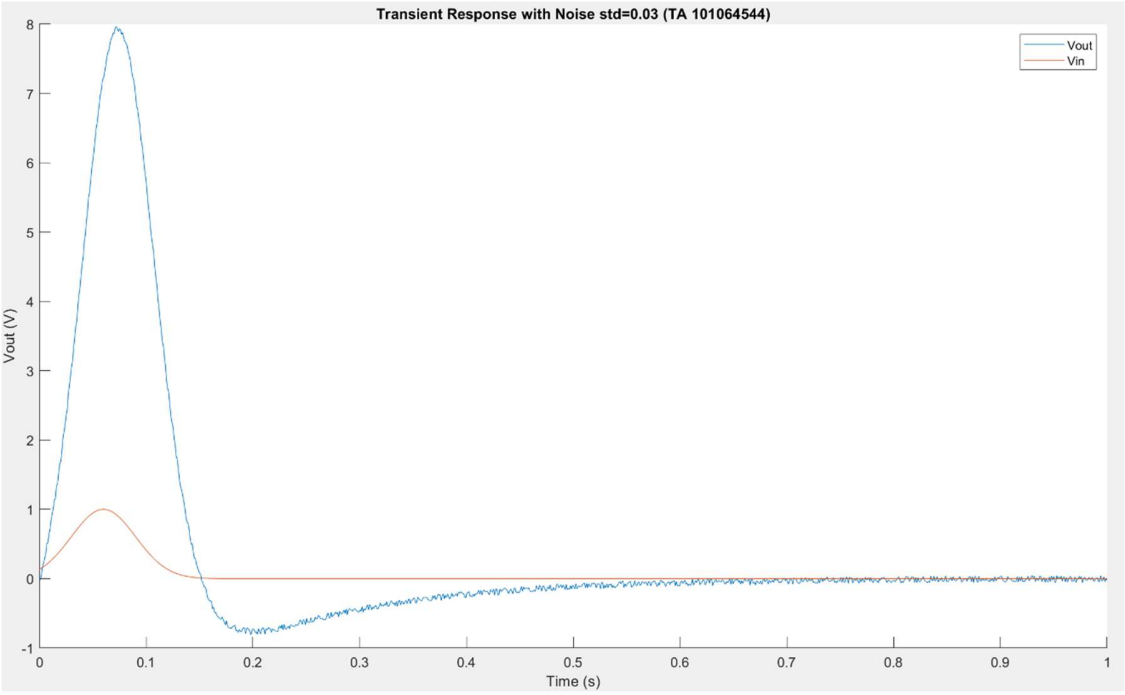

Step Function Frequency Response (TA 101064544)
Vout
Vin
Magnitude (dBV)
80
60
40
20
0
-20
-40
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5
Frequency (Hz)

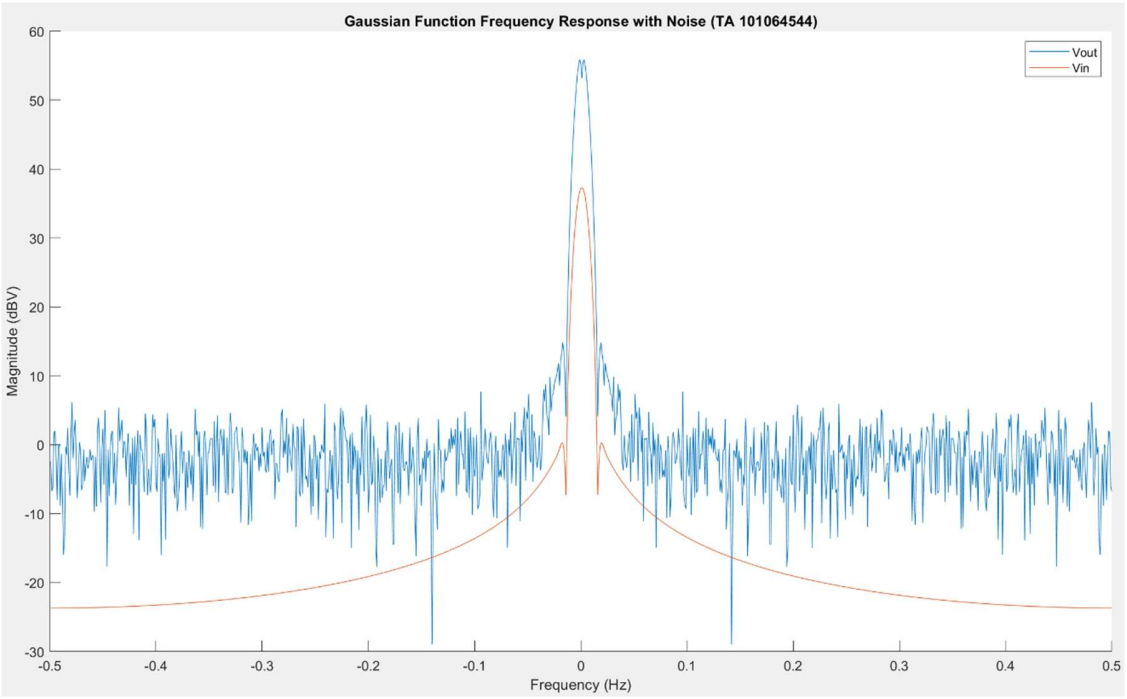

Sine Function Transient Response (TA 101064544)
Vout
Vin
Vout (V)
4
3
2
1
0
-1
-2
-3
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Time (s)

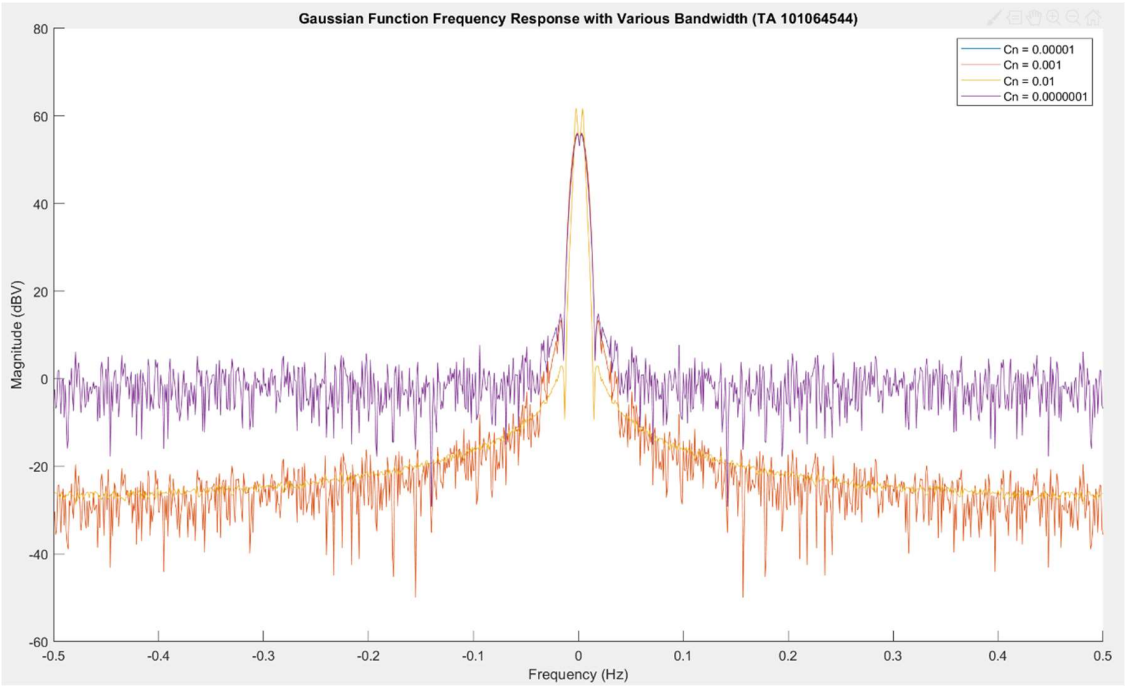

Sine Function Frequency Response (TA 101064544)
Vout
Vin
Magnitude (dBV)
Frequency (Hz)
60
50
40
30
20
10
0
-10
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5

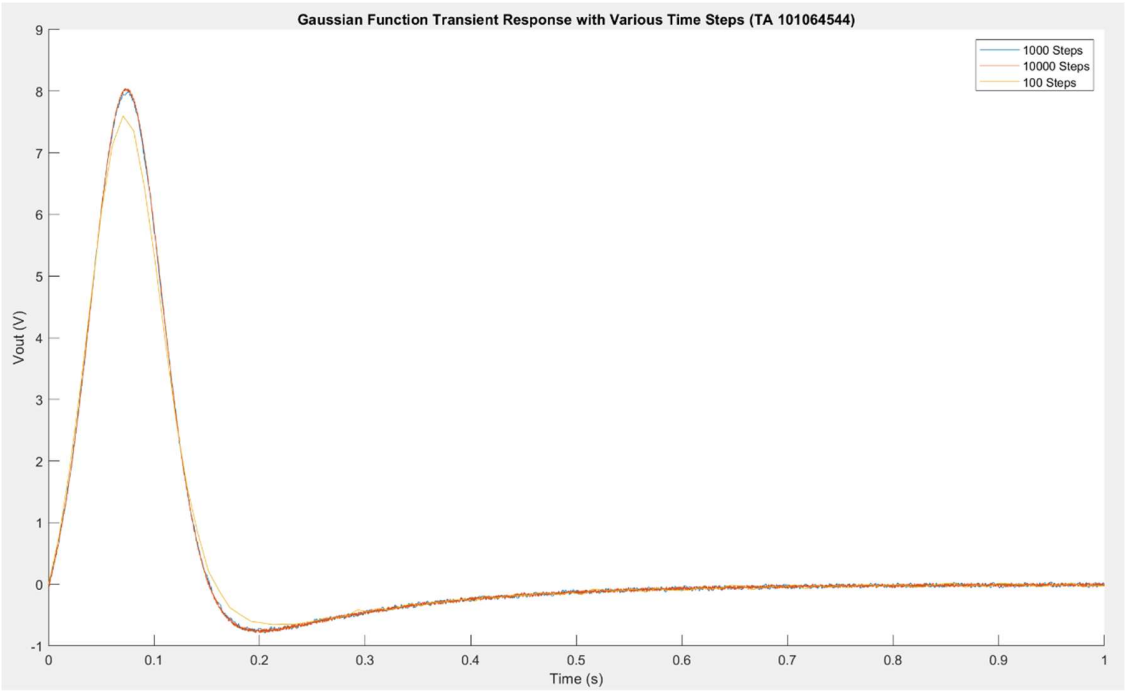

Gaussian Function Transient Response (TA 101064544)
Vout
Vin
Vout (V)
Time (s)
8
7
6
5
4
3
2
1
0
-1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


Gaussian Function Frequency Response (TA 101064544)
Vout
Vin
Magnitude (dBV)
Frequency (Hz)
60
50
40
30
20
10
0
-10
-20
-30
-40
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5


Transient Response with Noise std=0.03 (TA 101064544)
Vout
Vin
Vout (V)
Time (s)
8
7
6
5
4
3
2
1
0
-1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


Gaussian Function Frequency Response with Noise (TA 101064544)
Vout
Vin
Magnitude (dBV)
Frequency (Hz)
60
50
40
30
20
10
0
-10
-20
-30
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5


Gaussian Function Frequency Response with Various Bandwidth (TA 101064544)
Cn = 0.00001
Cn = 0.001
Cn = 0.01
Cn = 0.0000001
Magnitude (dBV)
Frequency (Hz)
80
60
40
20
0
-20
-40
-60
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5


Gaussian Function Transient Response with Various Time Steps (TA 101064544)
1000 Steps
10000 Steps
100 Steps
Vout (V)
Time (s)
9
8
7
6
5
4
3
2
1
0
-1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1