Carleton University

Elec4700 Assignment 4

Circuit Modeling

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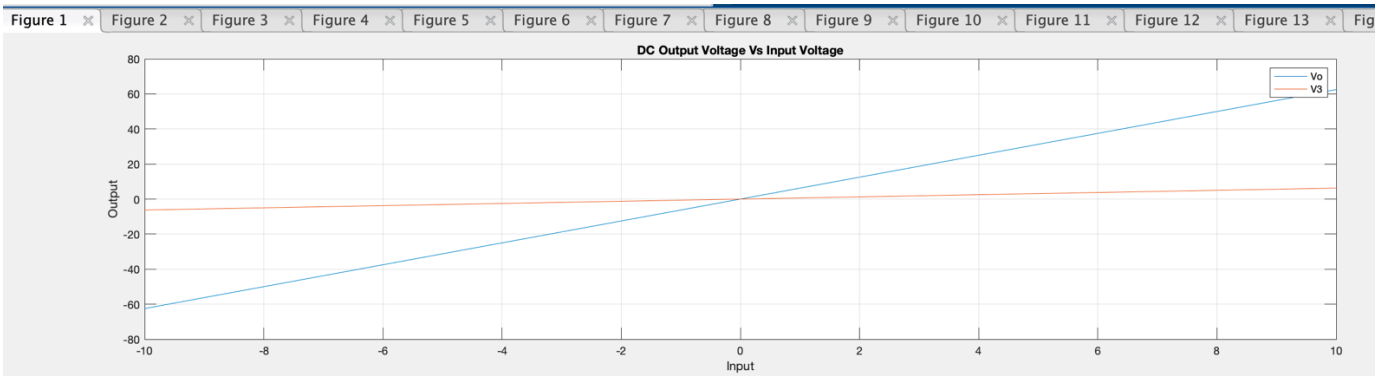
Part 1:

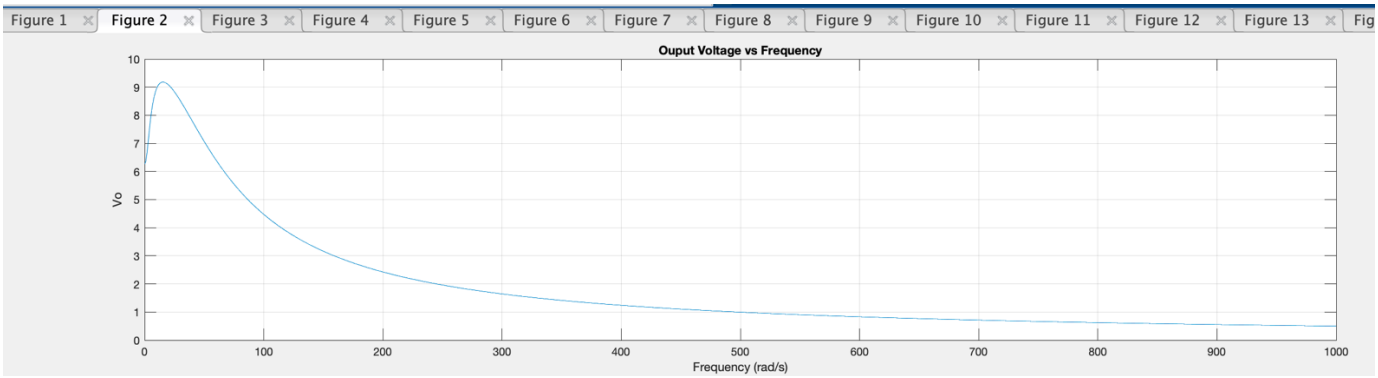
```
G =

    1.0000         0         0         0         0         0         0
   -1.0000    1.5000         0         0         0    1.0000         0
         0         0    0.1000         0         0   -1.0000         0
         0         0    0.1000         0         0         0   -1.0000
         0         0         0  -10.0000   10.0010         0         0
         0    1.0000   -1.0000         0         0         0         0
         0         0         0    1.0000         0         0 -100.0000


Cm =

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





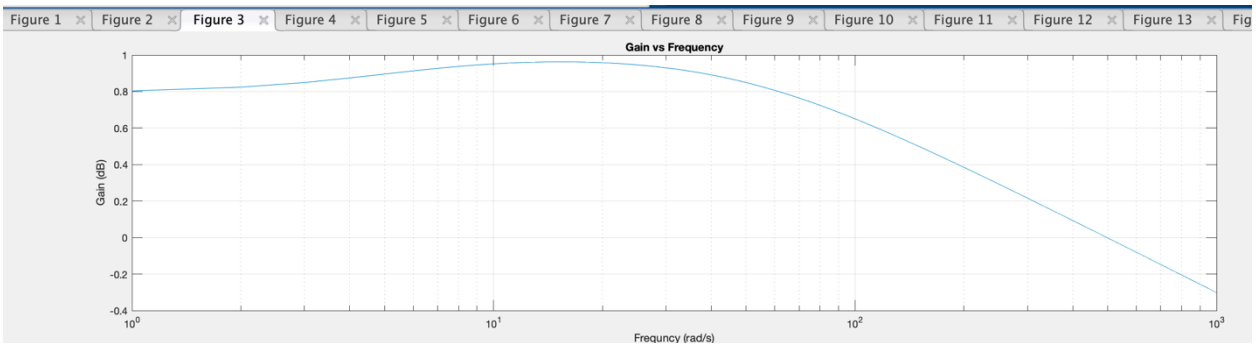


Figure 1 Figure 2 Figure 3 Figure 4 Figure 5 Figure 6 Figure 7 Figure 8 Figure 9 Figure 10 Figure 11 Figure 12 Figure 13
Gain vs Frequency
Gain (dB)
Frequncy (rad/s)

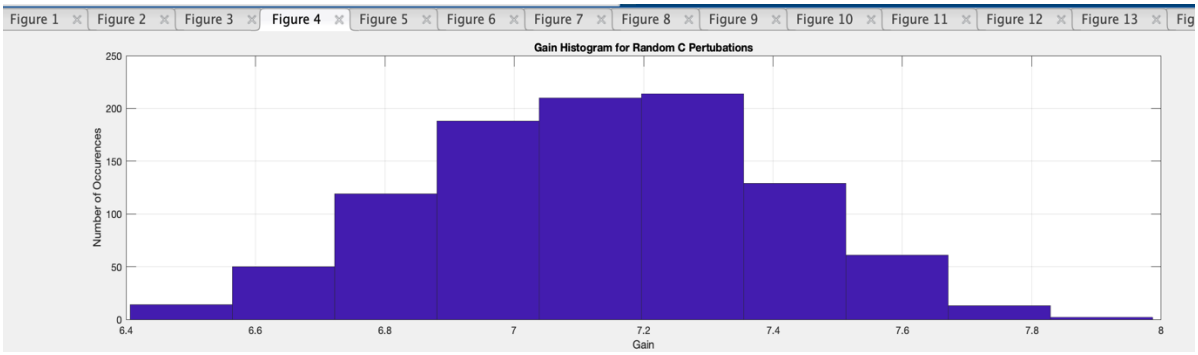


Figure 1 Figure 2 Figure 3 Figure 4 Figure 5 Figure 6 Figure 7 Figure 8 Figure 9 Figure 10 Figure 11 Figure 12 Figure 13
Gain Histogram for Random C Pertubations
Number of Occurences
Gain

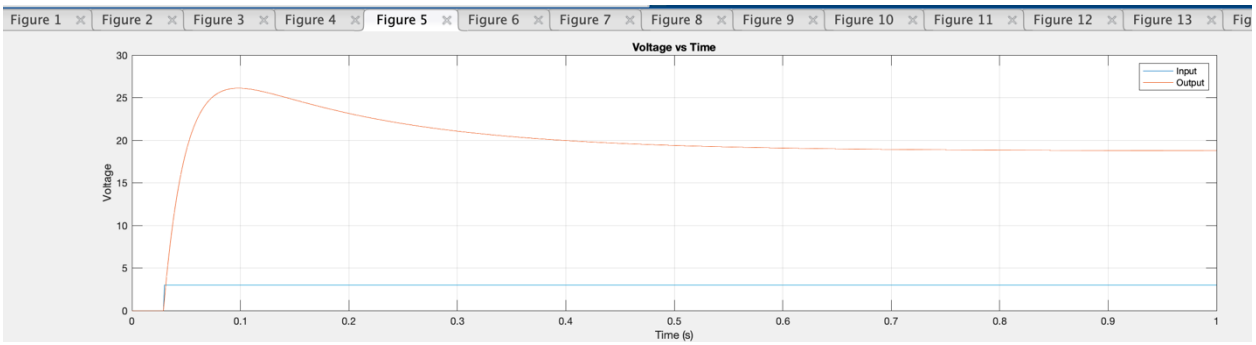


Figure 1 Figure 2 Figure 3 Figure 4 Figure 5 Figure 6 Figure 7 Figure 8 Figure 9 Figure 10 Figure 11 Figure 12 Figure 13
Voltage vs Time
Input
Output
Voltage
Time (s)

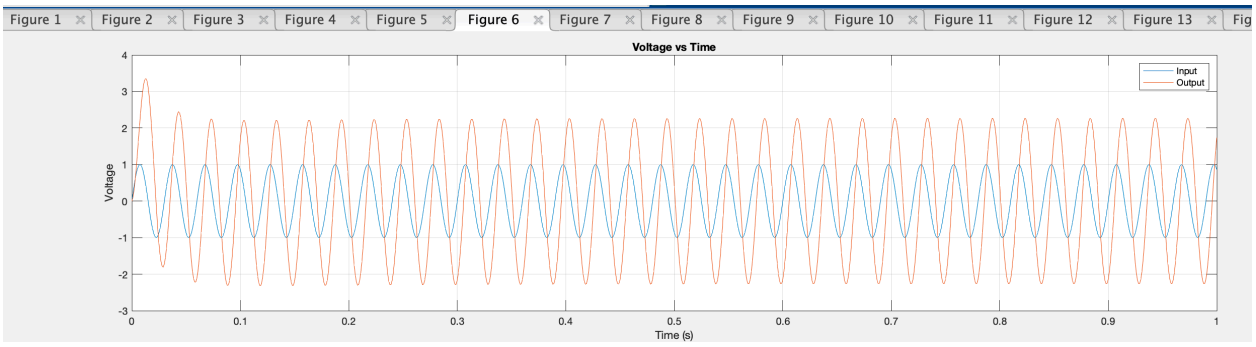


Figure 1 Figure 2 Figure 3 Figure 4 Figure 5 Figure 6 Figure 7 Figure 8 Figure 9 Figure 10 Figure 11 Figure 12 Figure 13
Voltage vs Time
Input
Output
Voltage
Time (s)

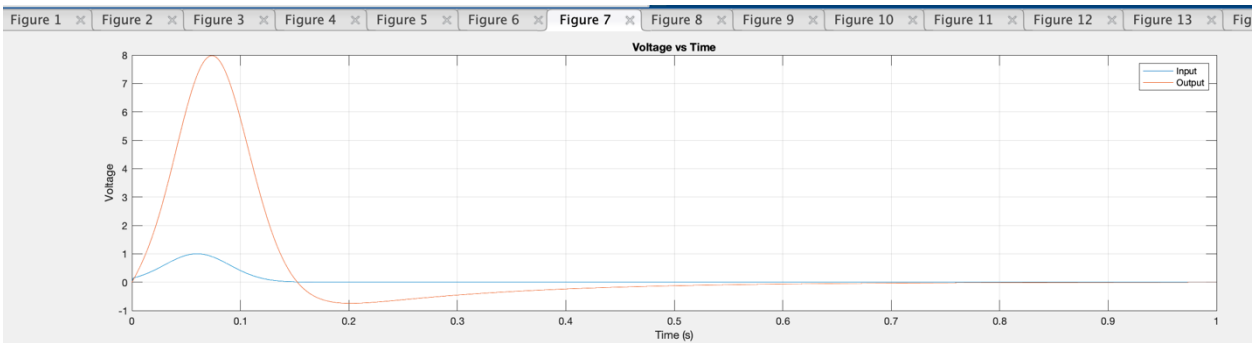


Figure 1 Figure 2 Figure 3 Figure 4 Figure 5 Figure 6 Figure 7 Figure 8 Figure 9 Figure 10 Figure 11 Figure 12 Figure 13
Voltage vs Time
Input
Output
Voltage
Time (s)

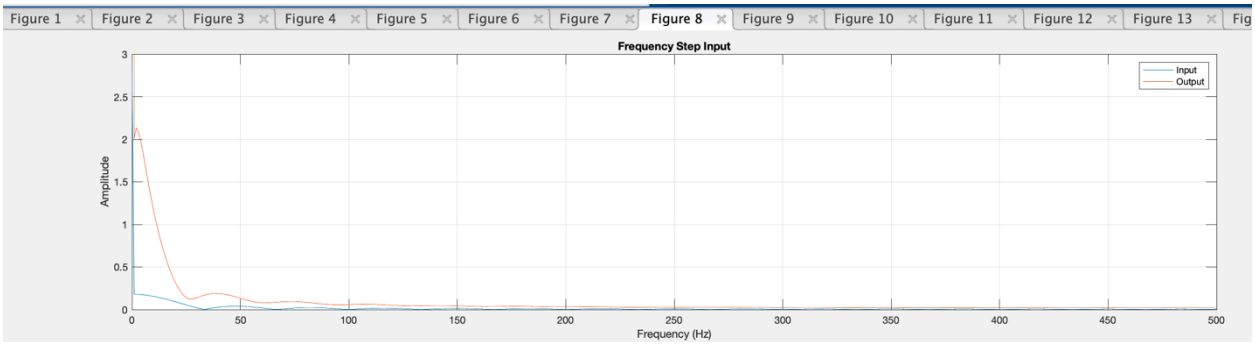


Figure 1 Figure 2 Figure 3 Figure 4 Figure 5 Figure 6 Figure 7 Figure 8 Figure 9 Figure 10 Figure 11 Figure 12 Figure 13
Frequency Step Input
Input
Output
Amplitude
Frequency (Hz)

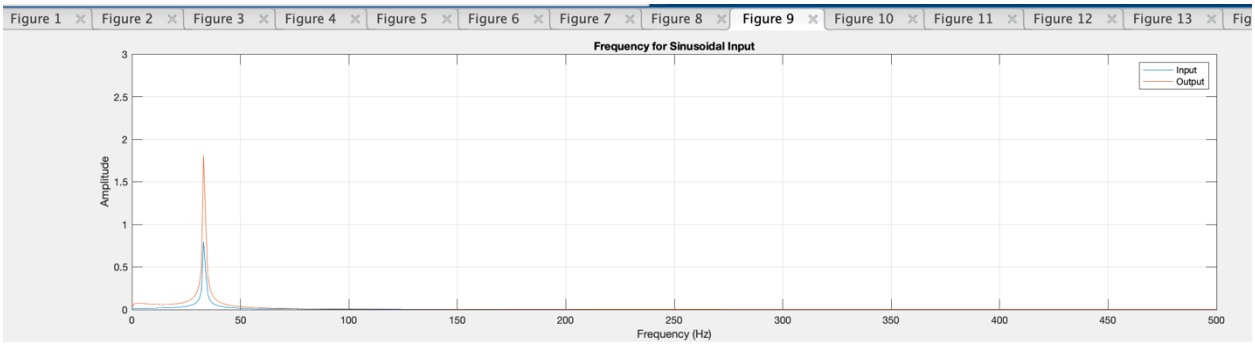


Figure 1 Figure 2 Figure 3 Figure 4 Figure 5 Figure 6 Figure 7 Figure 8 Figure 9 Figure 10 Figure 11 Figure 12 Figure 13
Frequency for Sinusoidal Input
Input
Output
Amplitude
Frequency (Hz)

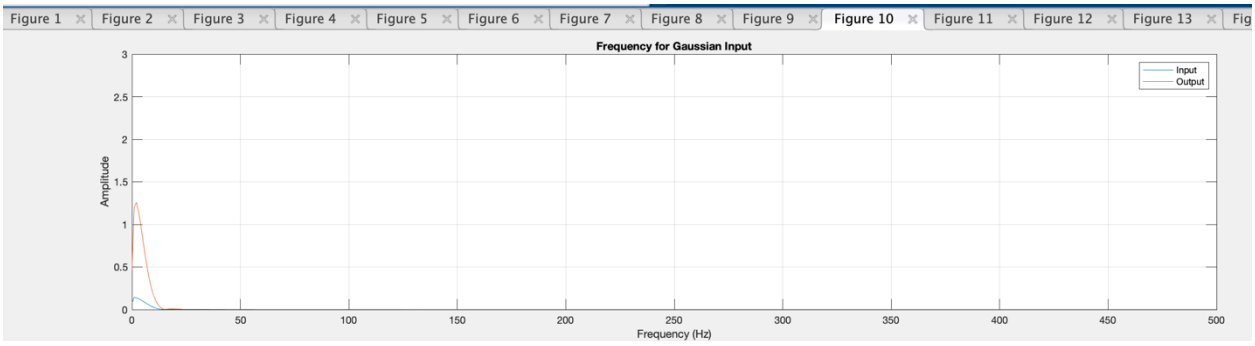


Figure 1 Figure 2 Figure 3 Figure 4 Figure 5 Figure 6 Figure 7 Figure 8 Figure 9 Figure 10 Figure 11 Figure 12 Figure 13
Frequency for Gaussian Input
Input
Output
Amplitude
Frequency (Hz)

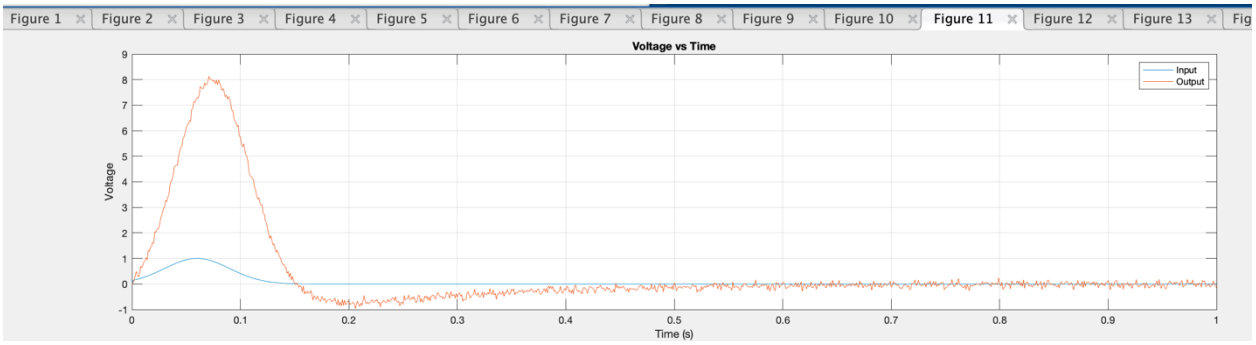
Circuit with Noise:

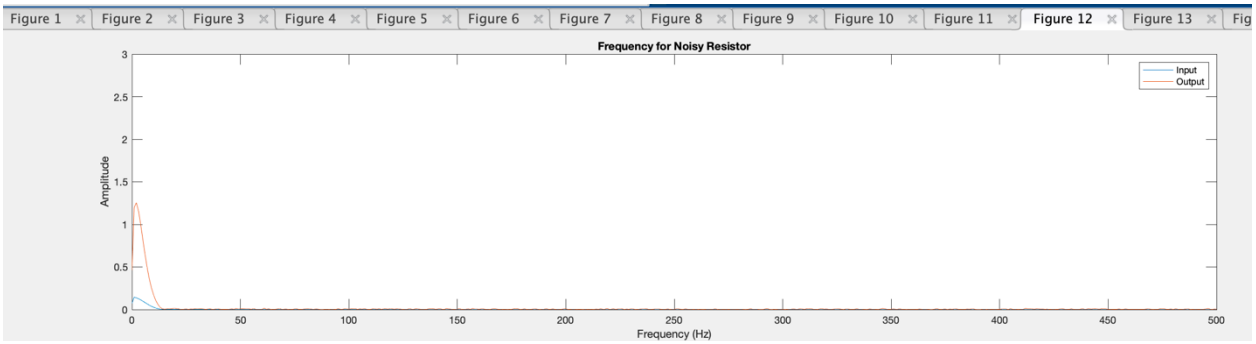
```
G =

    1.0000         0         0         0         0         0         0
   -1.0000    1.5000         0         0         0    1.0000         0
         0         0    0.1000         0         0   -1.0000         0
         0         0    0.1000         0         0         0   -1.0000
         0         0         0  -10.0000   10.0010         0         0
         0    1.0000   -1.0000         0         0         0         0
         0         0         0    1.0000         0         0 -100.0000


Cm =

         0         0         0         0         0         0         0
   -0.2500    0.2500         0         0         0         0         0
         0         0    0.0000         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
```





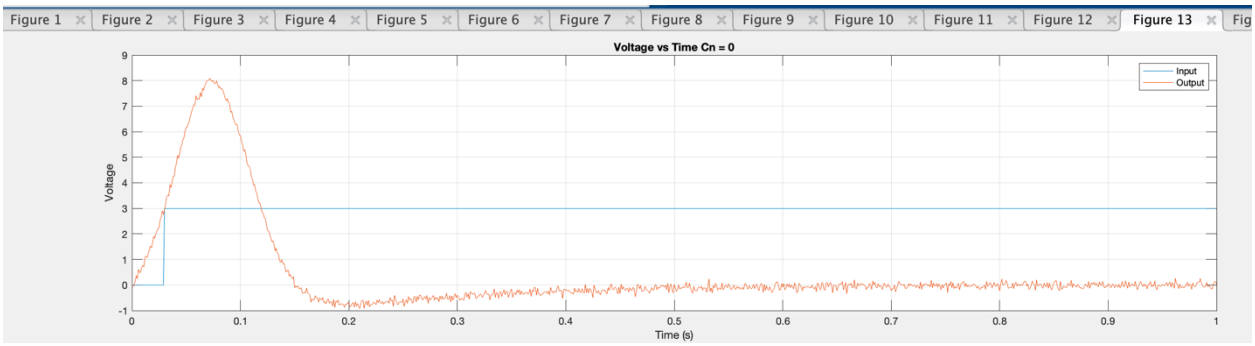


Figure 1 Figure 2 Figure 3 Figure 4 Figure 5 Figure 6 Figure 7 Figure 8 Figure 9 Figure 10 Figure 11 Figure 12 Figure 13
Voltage vs Time Cn = 0
Input
Output
Voltage
Time (s)

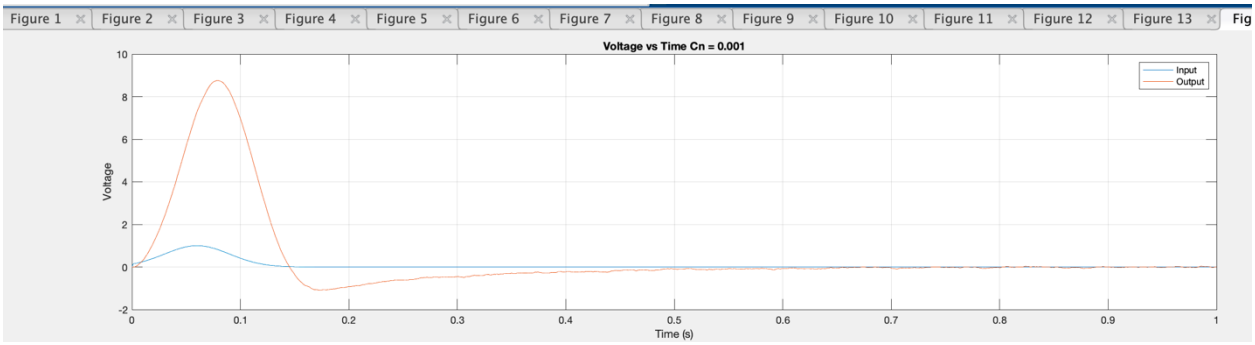


Figure 1 Figure 2 Figure 3 Figure 4 Figure 5 Figure 6 Figure 7 Figure 8 Figure 9 Figure 10 Figure 11 Figure 12 Figure 13
Voltage vs Time Cn = 0.001
Input
Output
Voltage
Time (s)

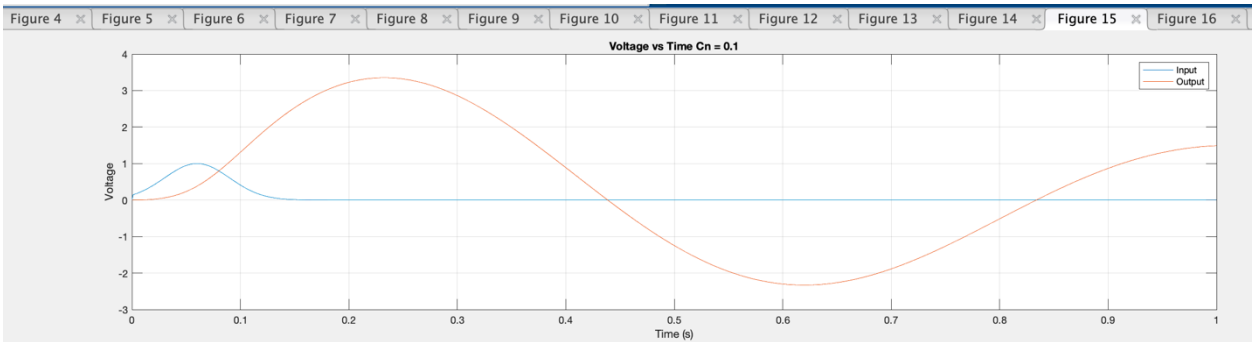


Figure 4 Figure 5 Figure 6 Figure 7 Figure 8 Figure 9 Figure 10 Figure 11 Figure 12 Figure 13 Figure 14 Figure 15 Figure 16
Voltage vs Time Cn = 0.1
Input
Output
Voltage
Time (s)

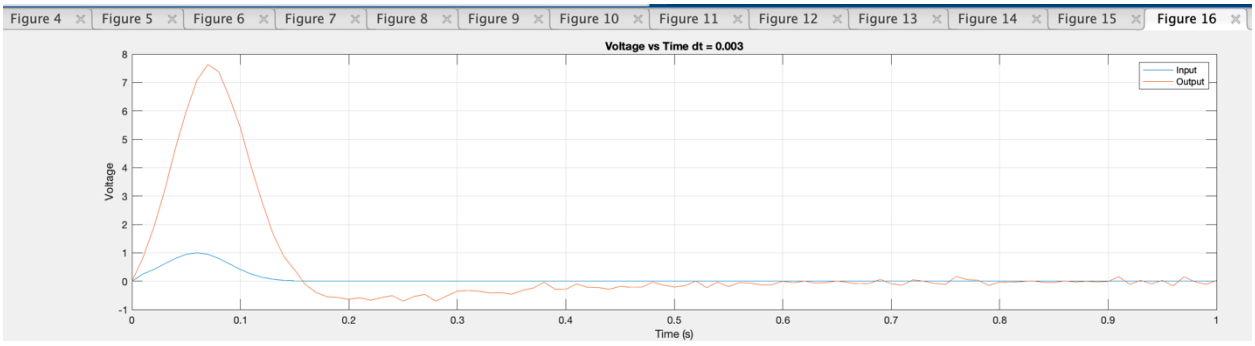
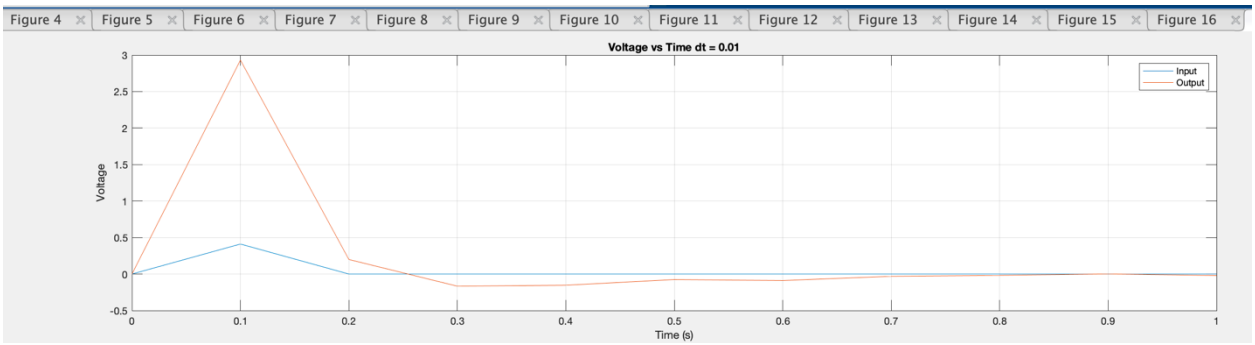


Figure 4 Figure 5 Figure 6 Figure 7 Figure 8 Figure 9 Figure 10 Figure 11 Figure 12 Figure 13 Figure 14 Figure 15 Figure 16
Voltage vs Time dt = 0.003
Input
Output
Voltage
Time (s)



Non-Linearity:

If the circuit was modeled by the transconductance equation $V = \alpha I_3 + \beta I_3^2 + \gamma I_3^3$. The simulations would to be altered to handle the non-linearity. A new column vector would be added, in order to deal with the non-linearity. The new vector would be added on the left of matrix equation such that a column B(V) and the system equation would change to the following:

V1 = V_in
G1(V2-V1) +C1 (d(V2-V1)/dt) +Il = 0
G3V3 – Il = 0
G3V3 – I3 = 0
G4(Vo-V4)GoVo = 0
V2 -V3-L dI/dt = 0
V4 – (AlphaI3 + BetaI3^2+SigmaI3^3) = 0