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ELEC 4700 ASSIGNMENT 4

QUESTION 1

In order to do the voltage sweep, the electrons were scattered within the bottle neck and the voltage was changed and then plotted against current.

This plot can be seen below:

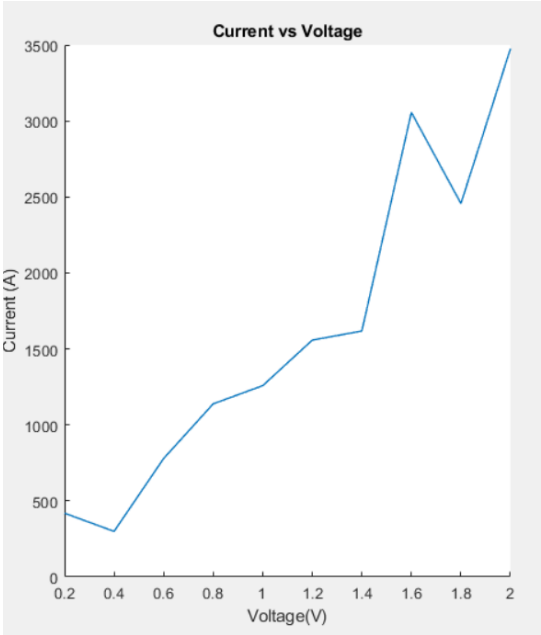

Figure 1

QUESTION 2

In order to find the resistance value for R3, the slope was found and then the reciprocal was found. This was the value of R3. One issue however was that my resistance value was quite small. So for the duration of the assignment, I used the value R3 = 10 ohms.

Calculations can be seen here:

Finding slope using (y2-y1(/(x2-x1)

1550 A – 1200A/1.2 V-0.8V = 875 / ohms = 1.1 ohms

QUESTION 3

C Matrix can be seen below:

```
C =

  Columns 1 through 7

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

Figure 2

G matrix can be seen below:

```
G =

  Columns 1 through 7

    1.0000         0         0         0         0         0         0
    1.0000   -1.0000   -1.0000         0         0         0         0
   -1.0000         0    1.5000         0         0         0         0
         0         0         0    1.0000    0.1000         0         0
         0         0   -1.0000         0    1.0000         0         0
         0         0         0 -100.0000         0   -1.0000         0
         0         0         0         0         0   10.0000   -1.0000
         0         0         0         0         0  -10.0000         0
```

Figure 3

Plot of DC sweep seen below:

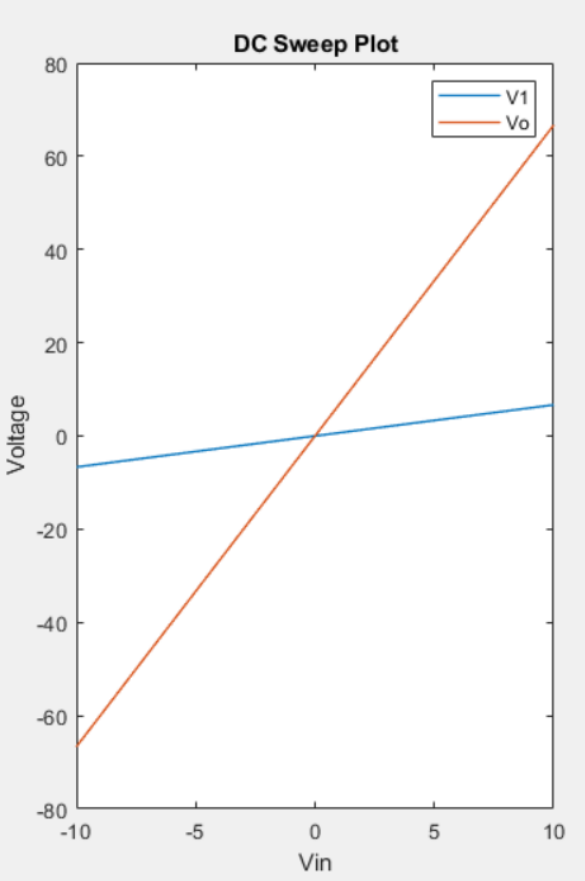

Figure 4

QUESTION 4

In this question, a step function is the voltage input into this circuit. The Step Function Transient Plot as well as the Step Function Frequency Response can be seen below.

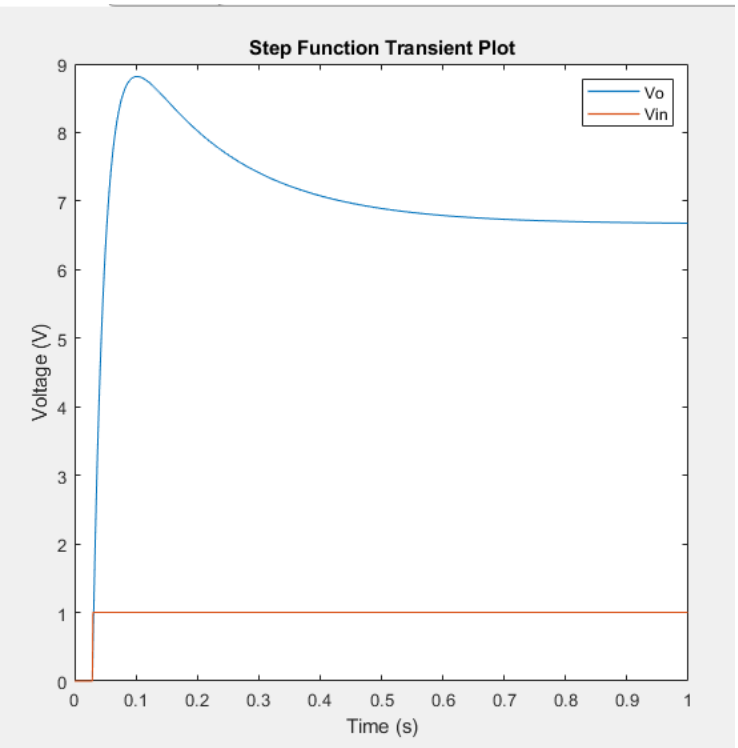

Figure 5

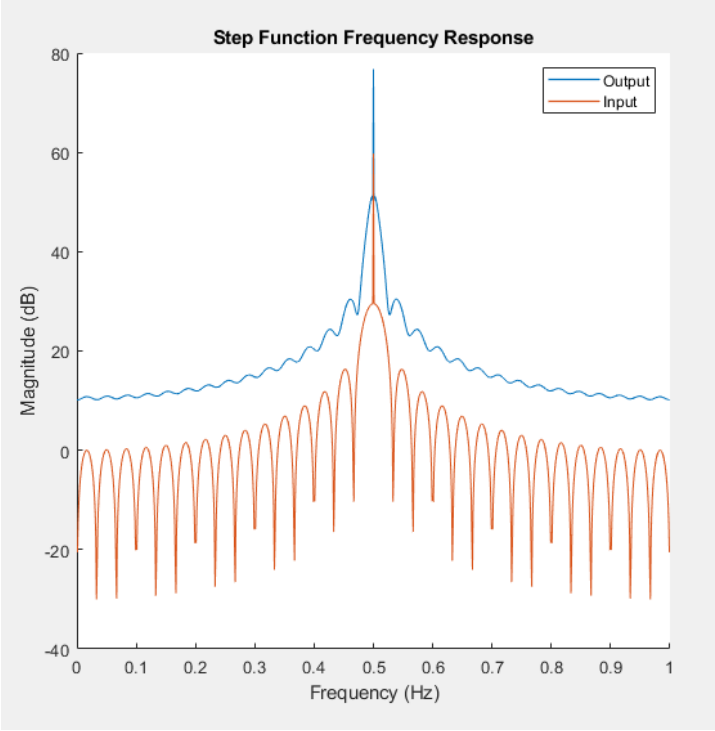

Figure 6

In this question, a sinusoidal function is the voltage input into this circuit. The Sine Function Transient Plot as well as the Sine Function Frequency Response can be seen below.

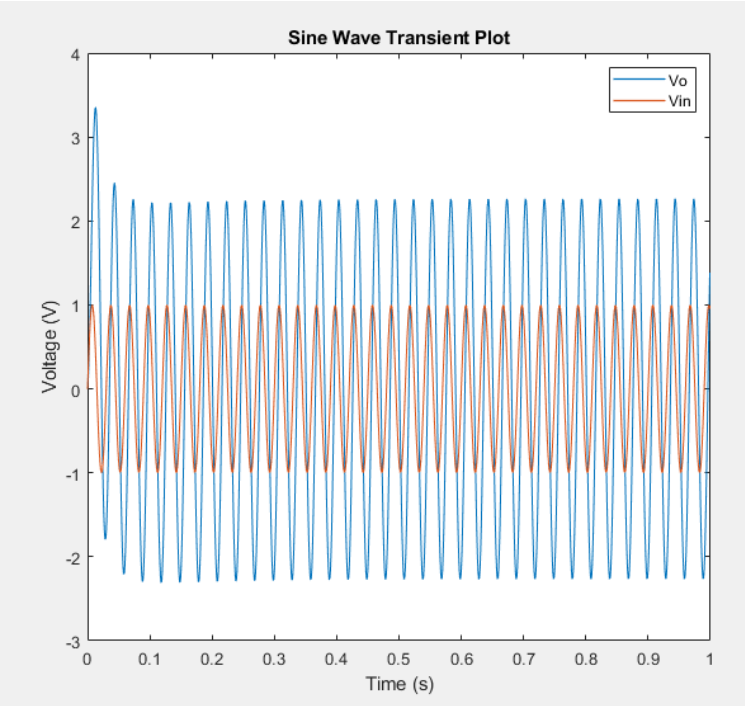

Figure 7

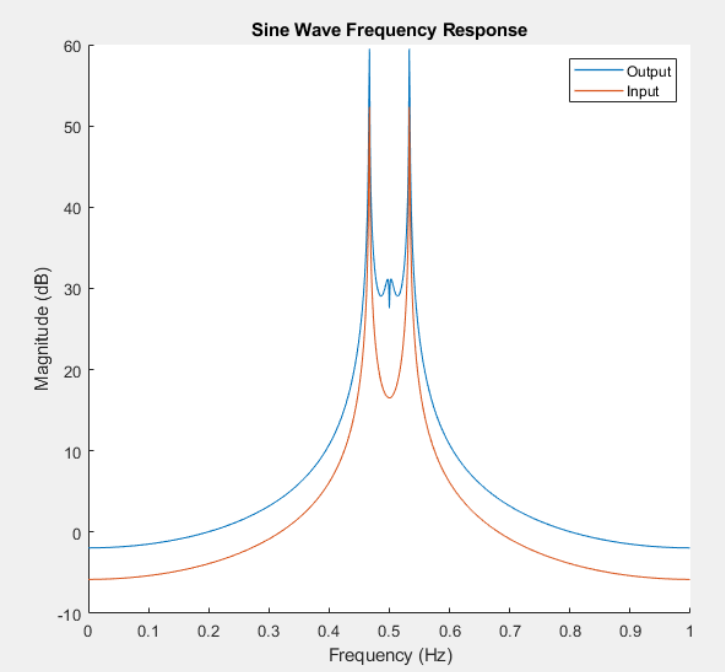

Figure 8

In this question, a gaussian pulse is the voltage input into this circuit. The gaussian pulse Transient Plot as well as the Gaussian pulse Frequency Response can be seen below.

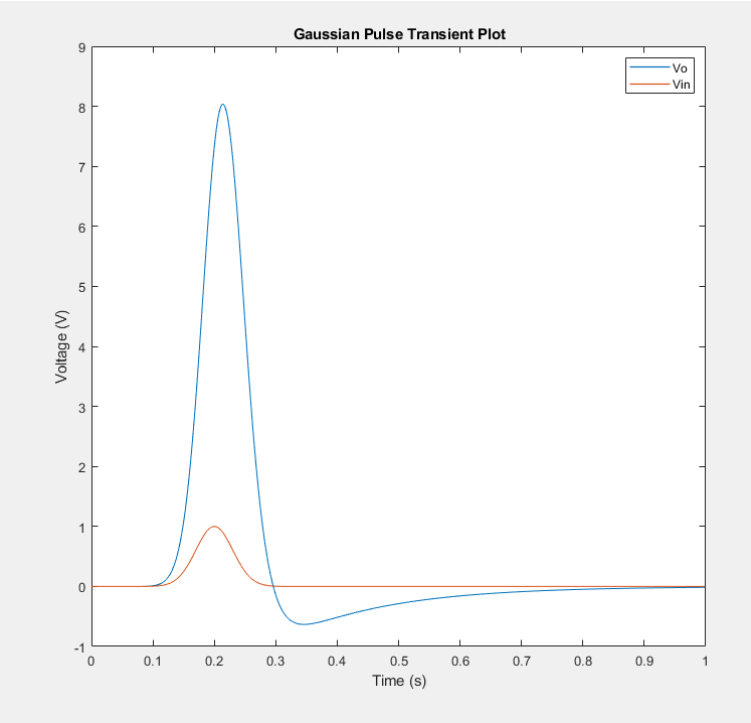

Figure 9

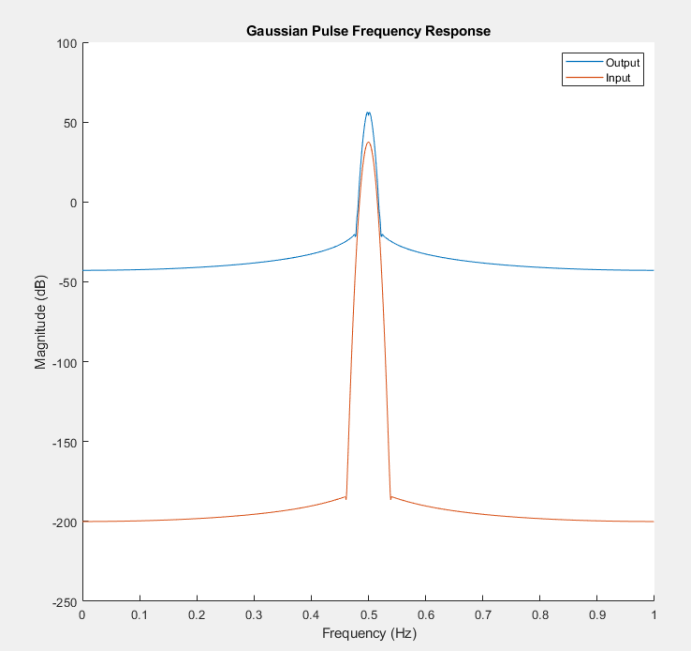

Figure 10

QUESTION 5

Updated C matrix seen below:

```
C =

  Columns 1 through 7

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

Figure 11

Noise was added to the circuit with a new current source and capacitor in parallel to R3.

To start off, Cn = 0.0001 F

The following is the gaussian pulse with noise plot:

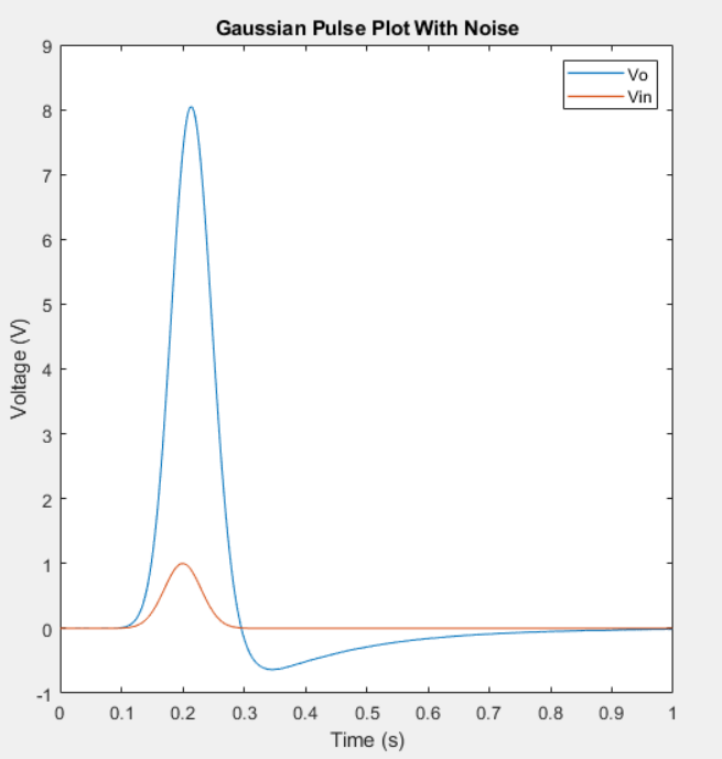

Figure 12

The following is a plot in the frequency domain with the noise added to the circuit:

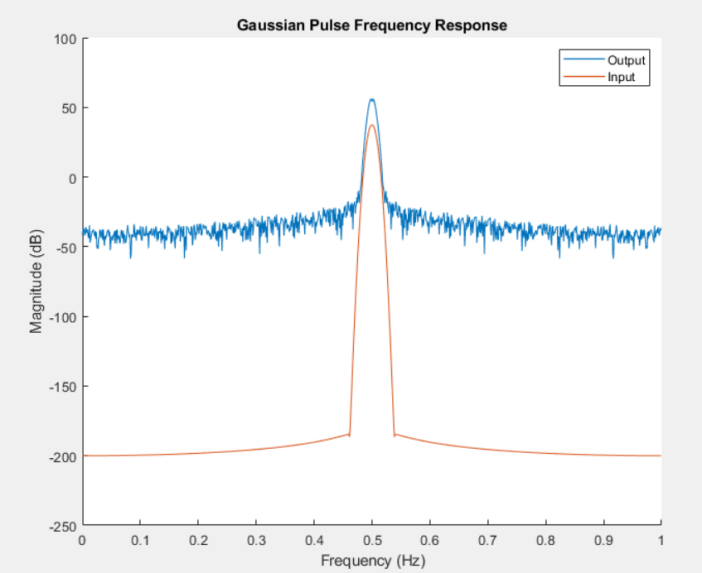

Figure 13

The following are plots of the gaussian pulse with different Cn values in order to create different Voltage outputs.

Plots when Cn = 0.001

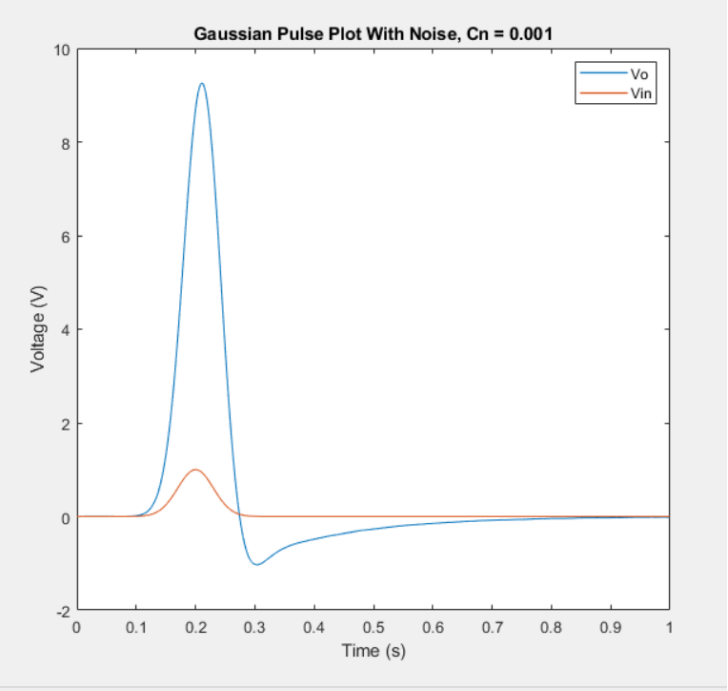

Figure 14

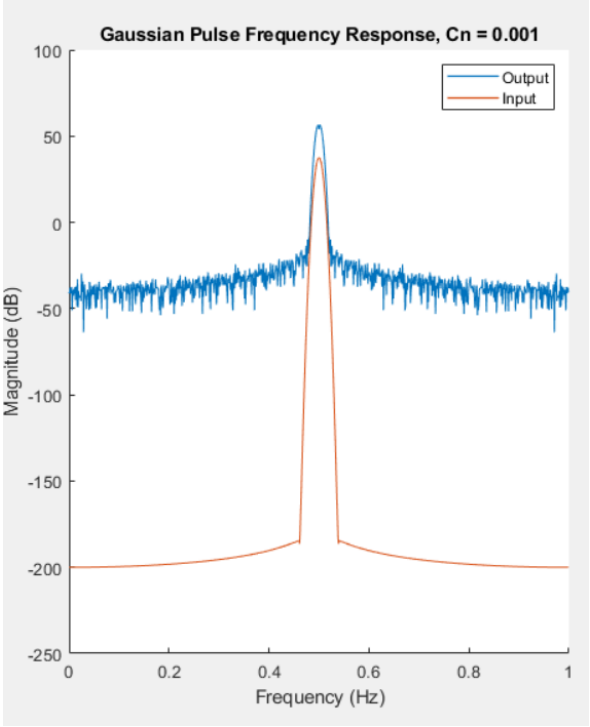

Figure 15

Plots with Cn = 0.01

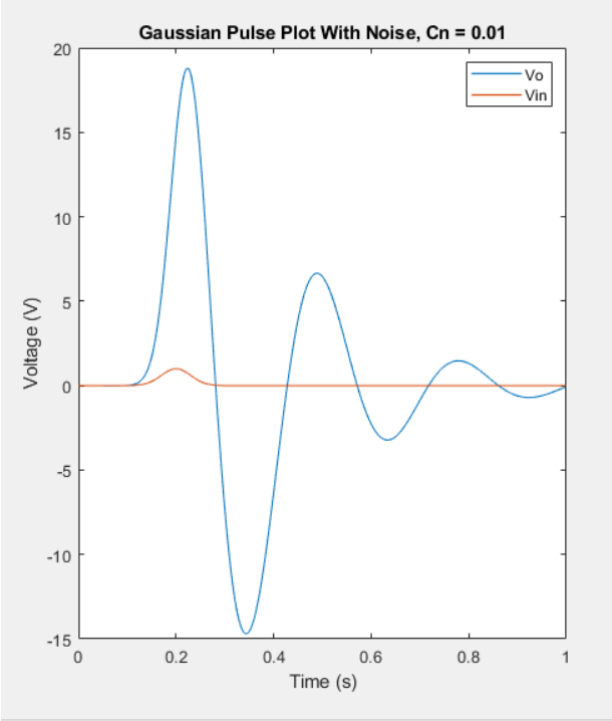

Figure 16

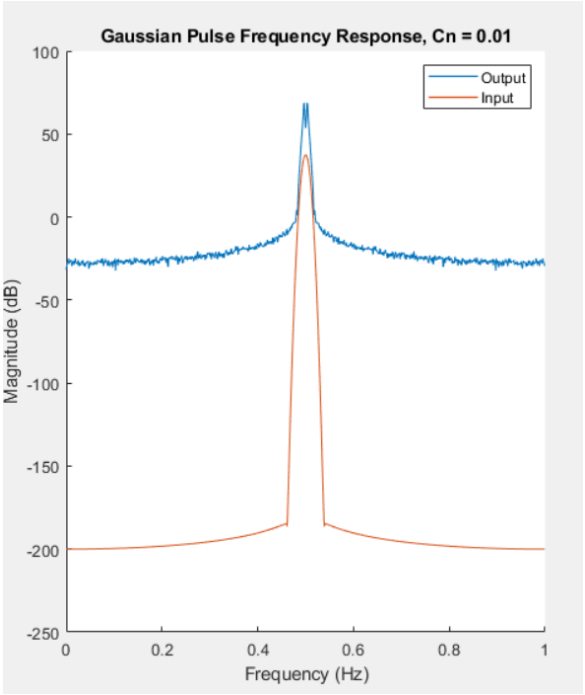

Figure 17

Plots with Cn = 0.1

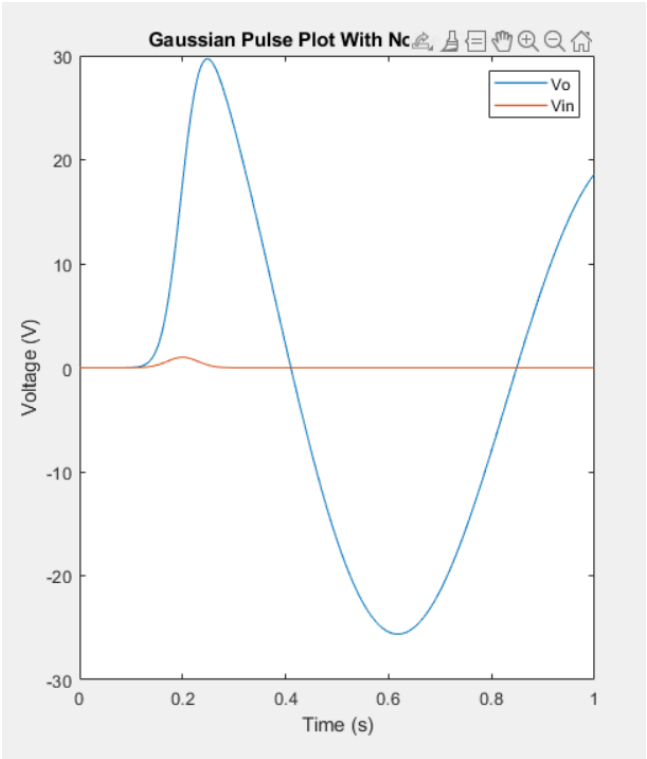

Figure 18

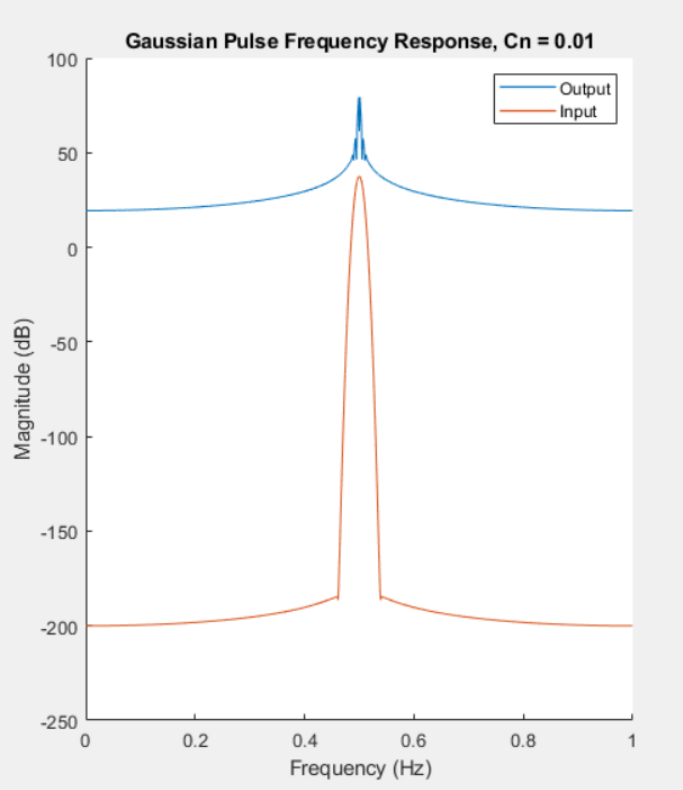

Figure 19

The following are the plots when different time steps are used. This whole question has used 1000 times steps up until this point. For this question, 100 time steps and 10000 time steps were used.

100 time steps:

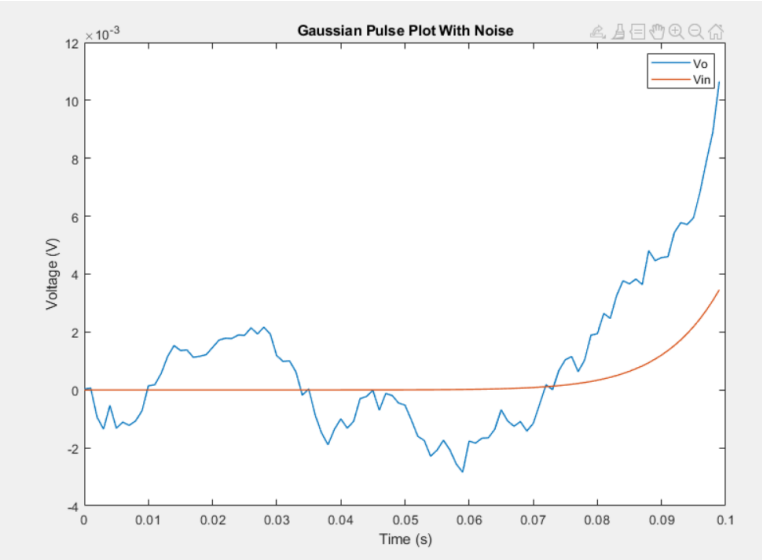

Figure 20

10000 time steps:

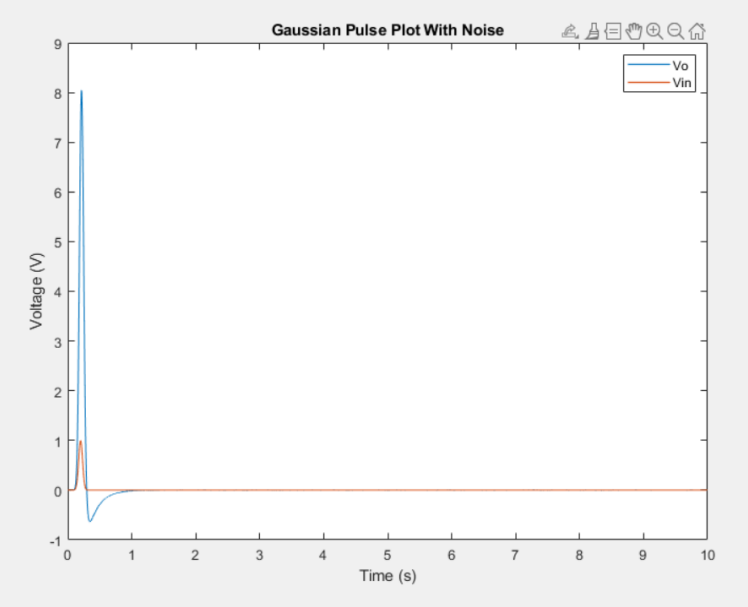

Figure 21

When the time step is changed, there is a difference. In Figure 20, we can see that with less time steps, the input looks cut off and the output has a lot of visible noise.

In Figure 21, we can see that there is more time for the code to be able to capture the input and output with enough time. The output plot looks better and complete.

QUESTION 6

In order to model this voltage in a non linear way, B vector, which represents the non linear components of the circuit must be considered. The equation would change to the following:

$$\hat{C}\frac{d\hat{V}}{dt} + \hat{G}\hat{V} + \hat{B}(\hat{V}) = \hat{F}(t$$

From the B vector, A Jacobian matrix can be created. Then using the Newton Raphson method, iteration can be used to solve for V.