ELEC 4700

Assignment 4

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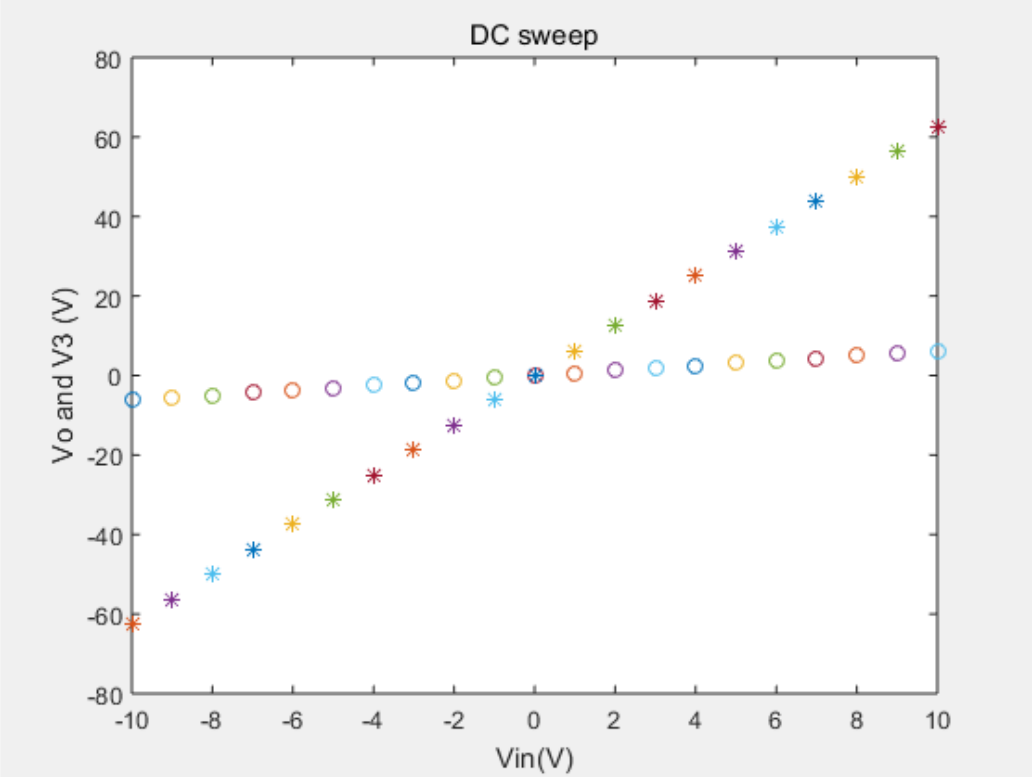
Part 1

a) C and G matrices

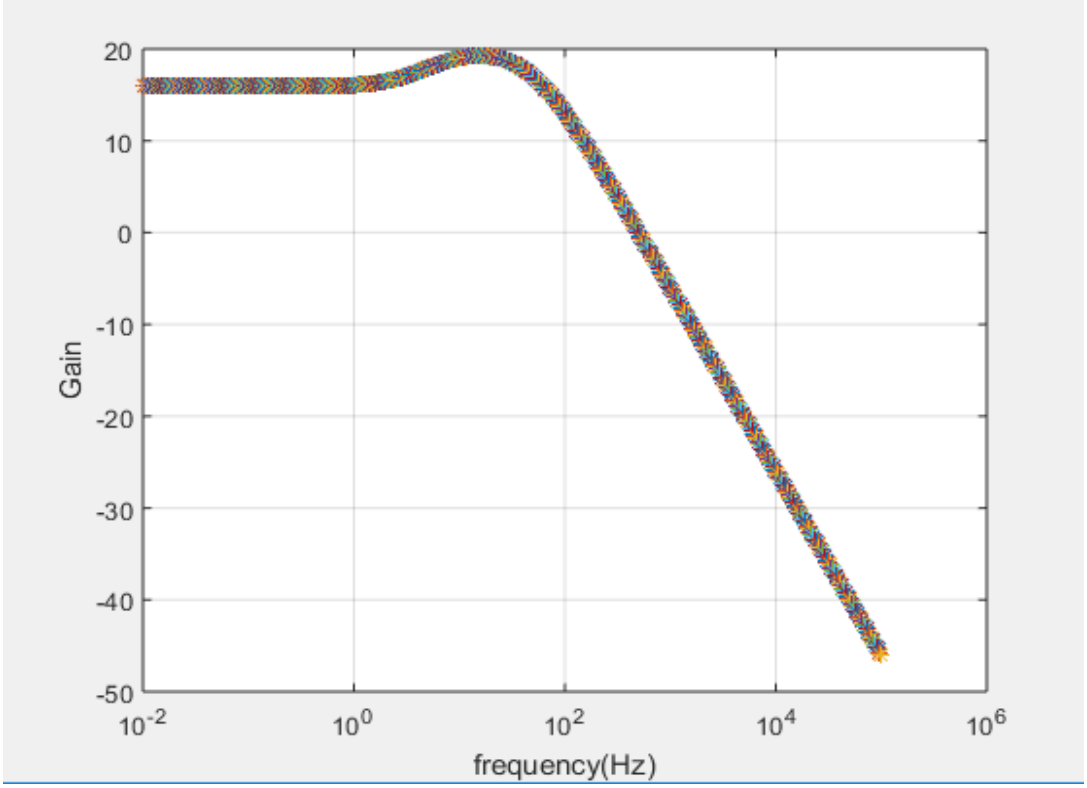
$$C = \begin{bmatrix} 0 & C & C & 0 & 0 & 0 & 0 & 0 \\ 0 & -C & C & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -L & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

$$G = \begin{bmatrix} -1 & 1/R1 & -1/R1 & 0 & 0 & 0 & 0 & 0 \\ 0 & -1/R1 & 1/R1 + 1/R2 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 & 1/R3 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & -1 & 1/R4 & -1/R4 \\ 0 & 0 & 0 & 0 & 0 & 0 & -1/R4 & 1/R4 + 1/R0 \\ 0 & 0 & 1 & 0 & -1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \alpha/R3 & 0 & -1 & 0 \end{bmatrix}$$

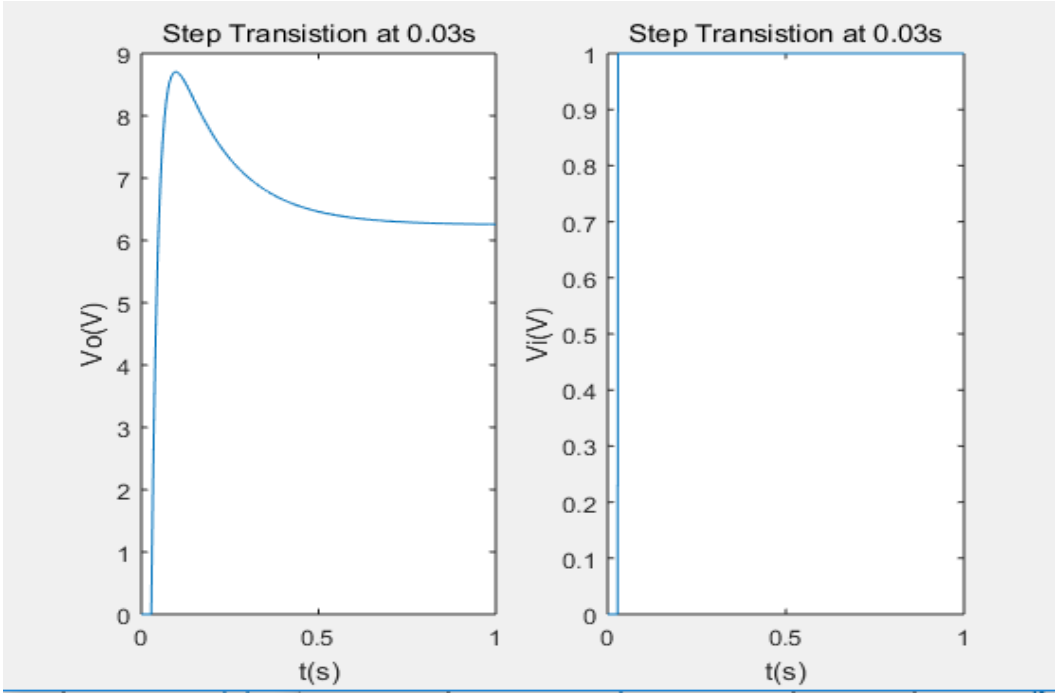
b) Plot of DC sweep



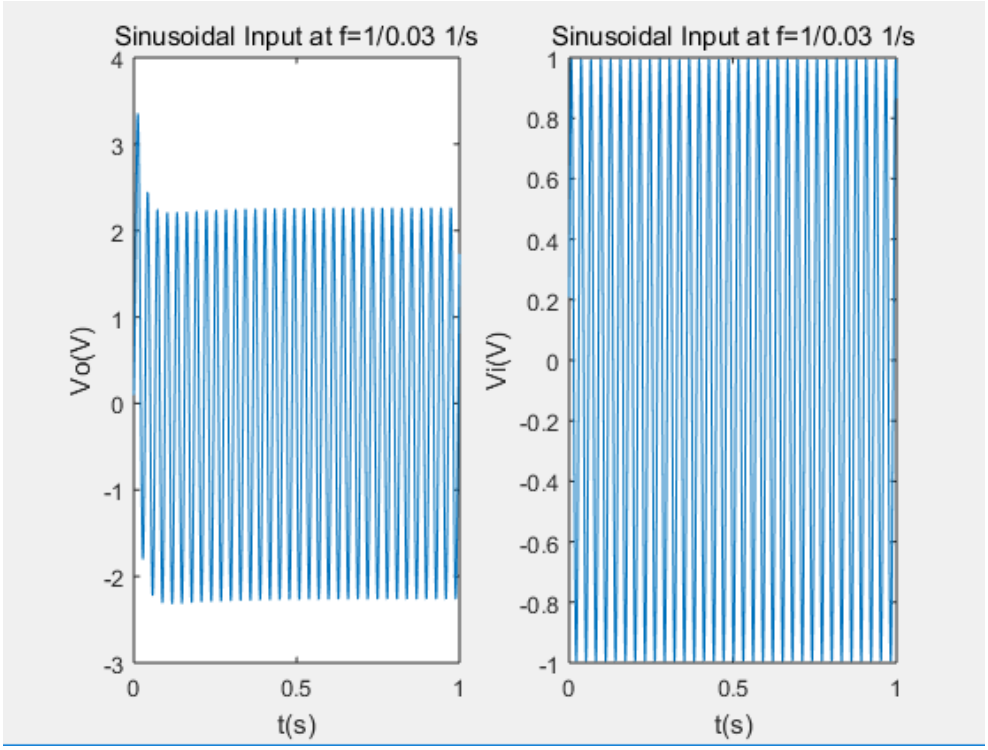
c) Plot of AC gain



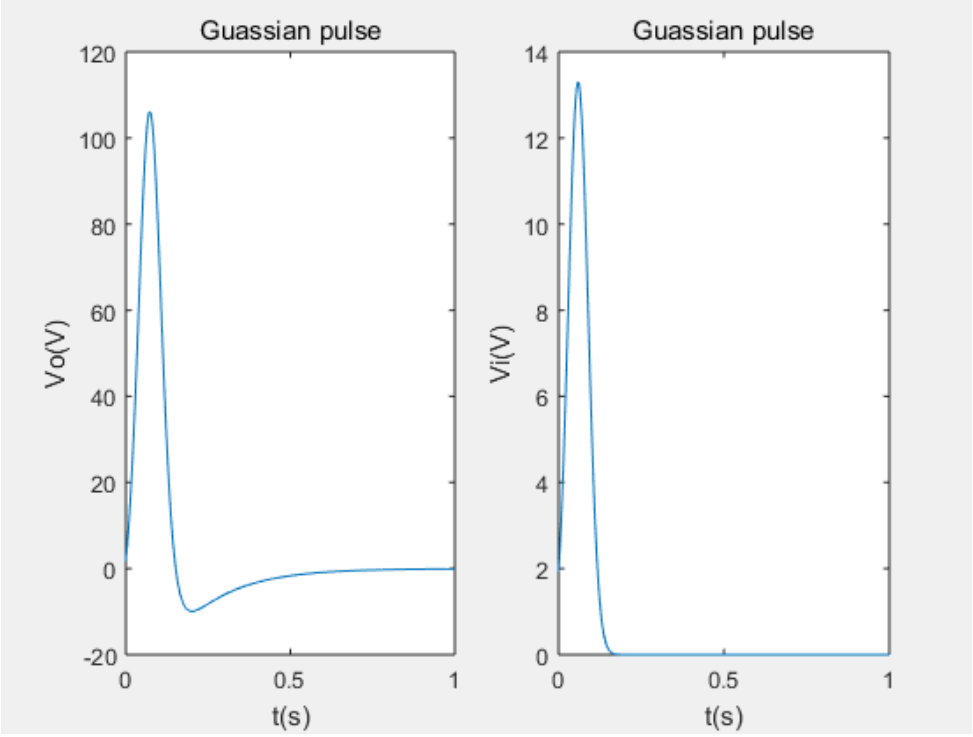
d) Step transition at t=0.03s



Sinusoidal Input

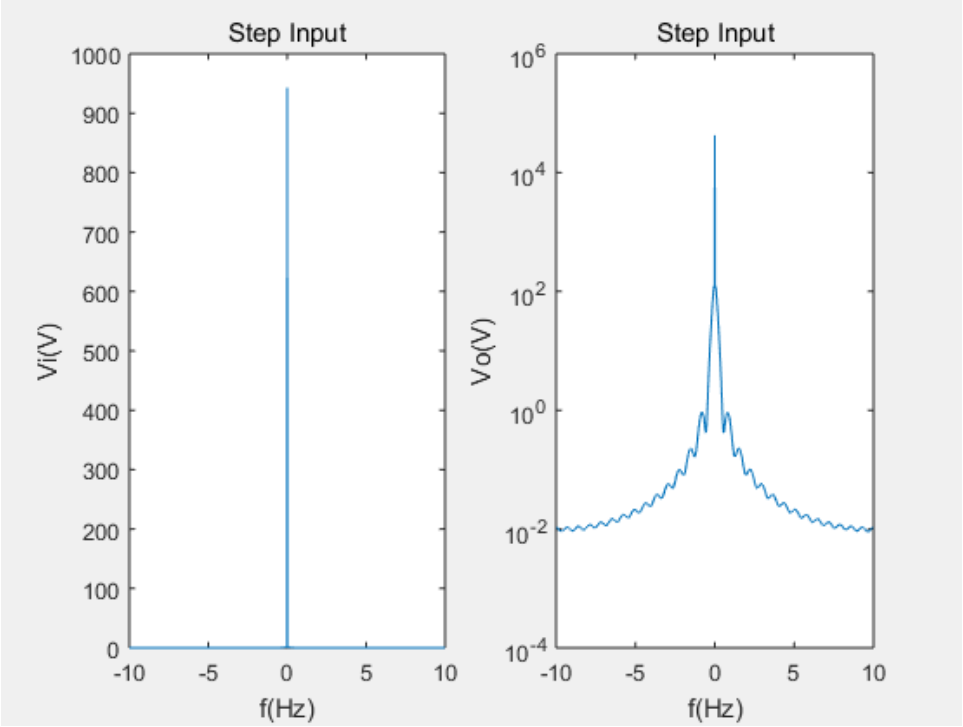


Gaussian pulse

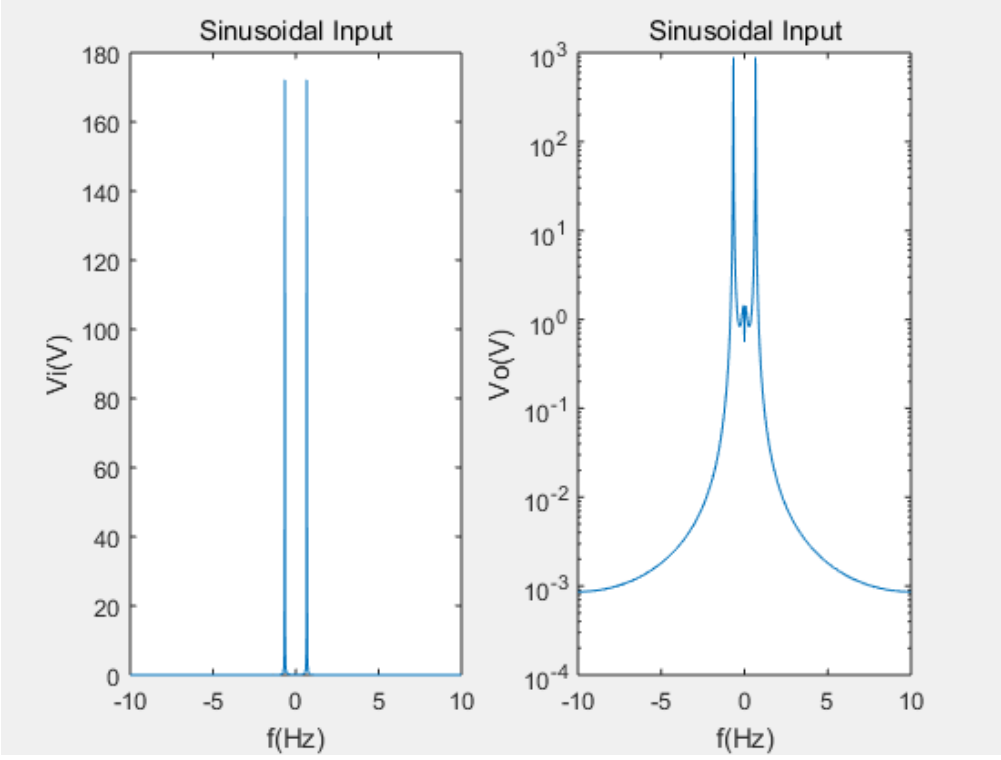


e) Fourier Transform plots of frequency response

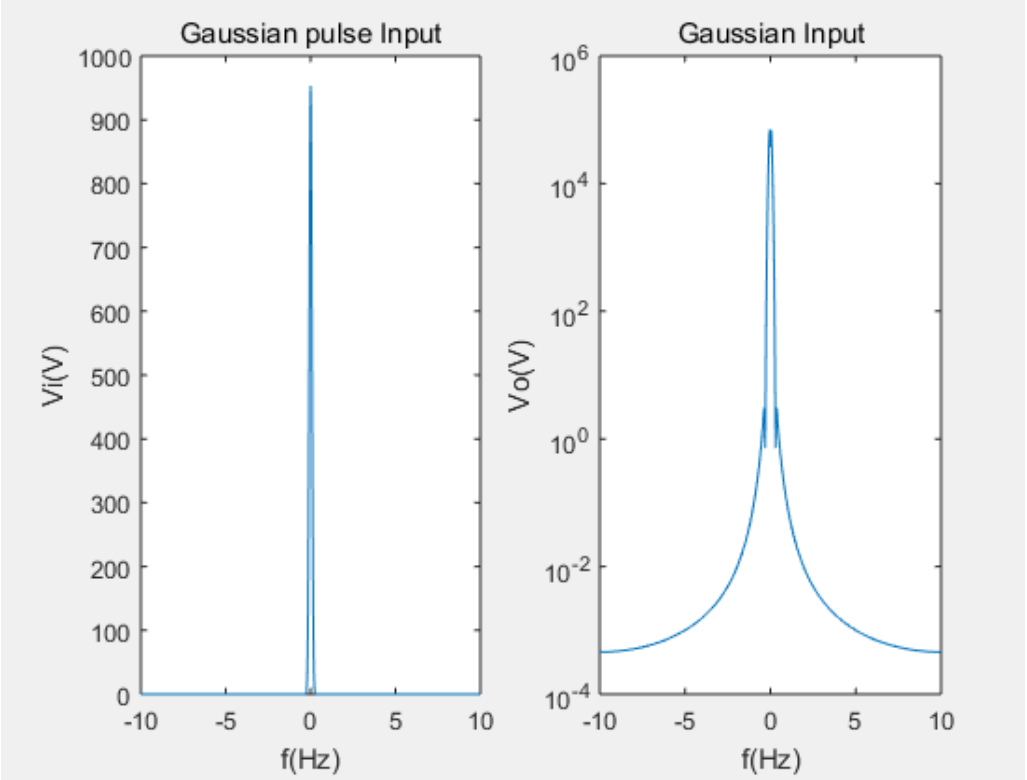
Step Transition



Sinusoidal Input



Gaussian pulse

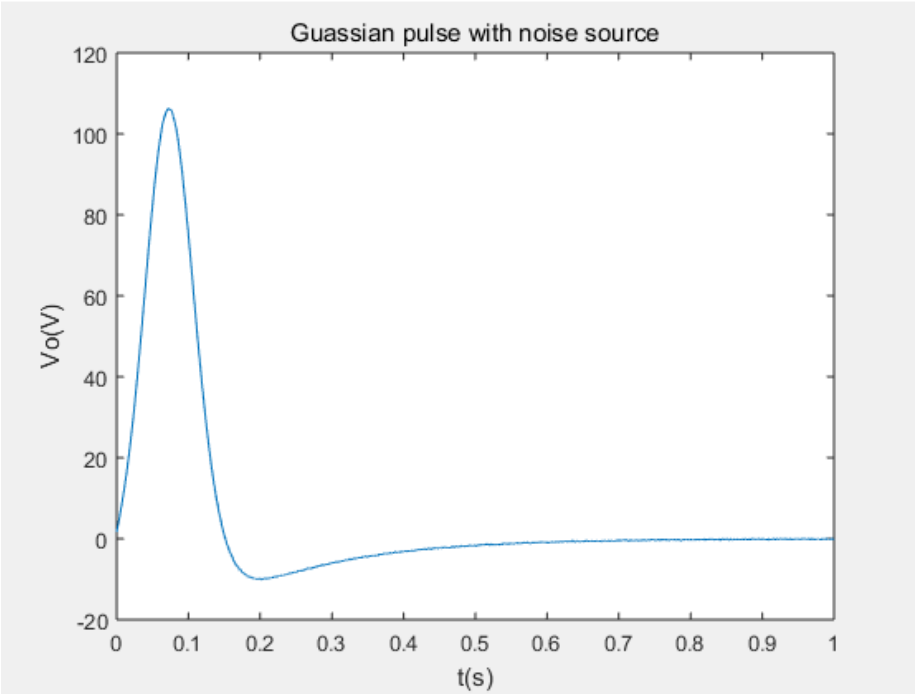


PART 2

a) Updated C matrix

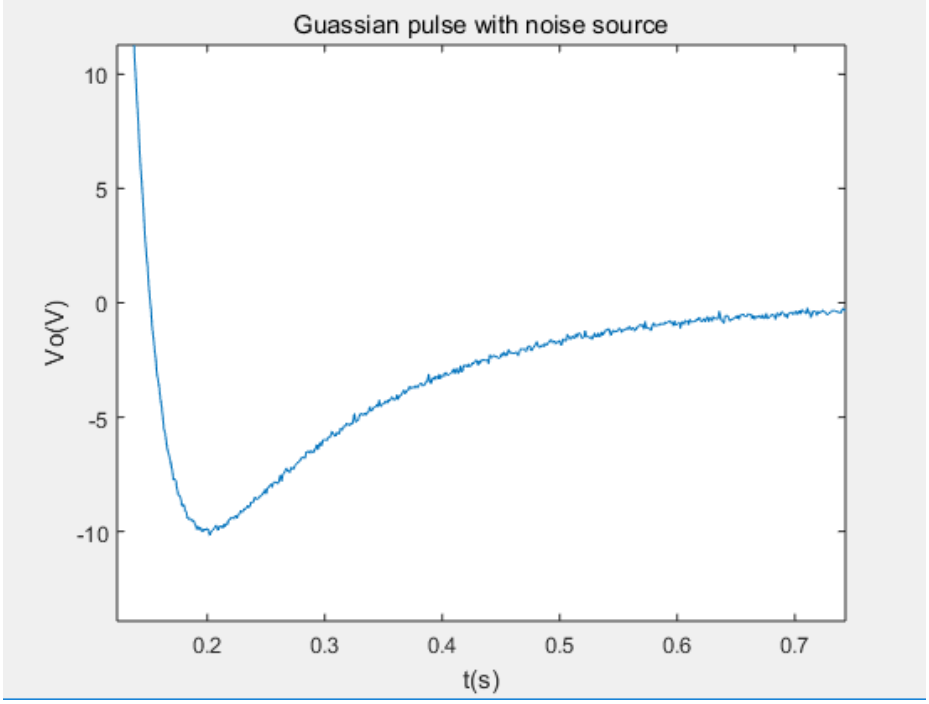
$$C = \begin{bmatrix} 0 & C & C & 0 & 0 & 0 & 0 & 0 \\ 0 & -C & C & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & Cn & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -L & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

b) Plot of Vout with noise source

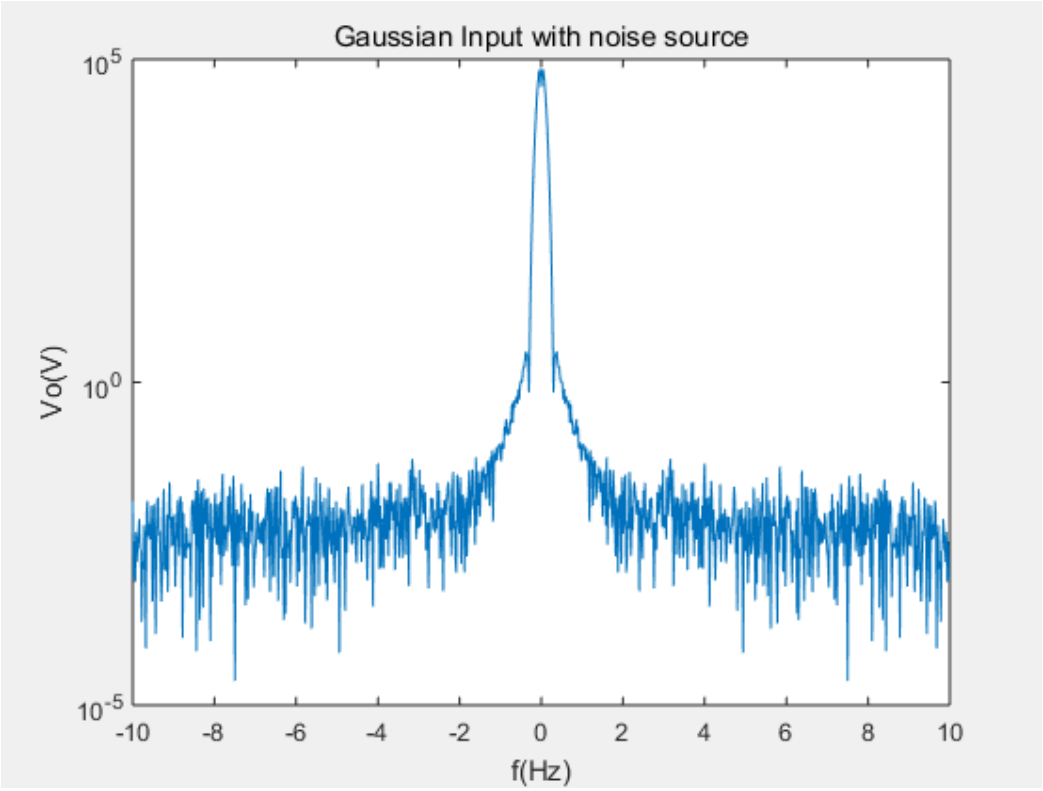


Vout vs t (Cn=0.00001, dt=0.001)

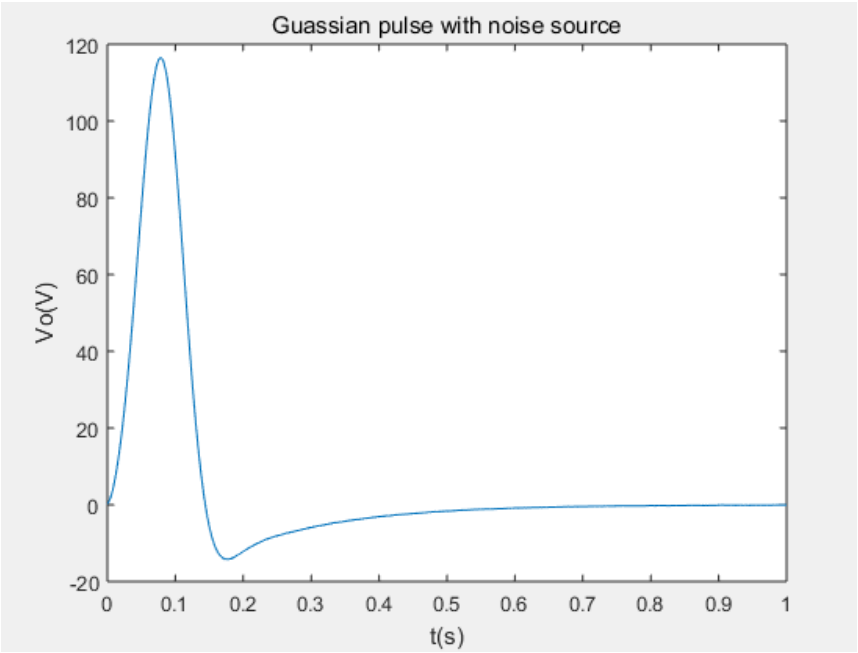
Plot of Vout with noise source (Zoomed in version)



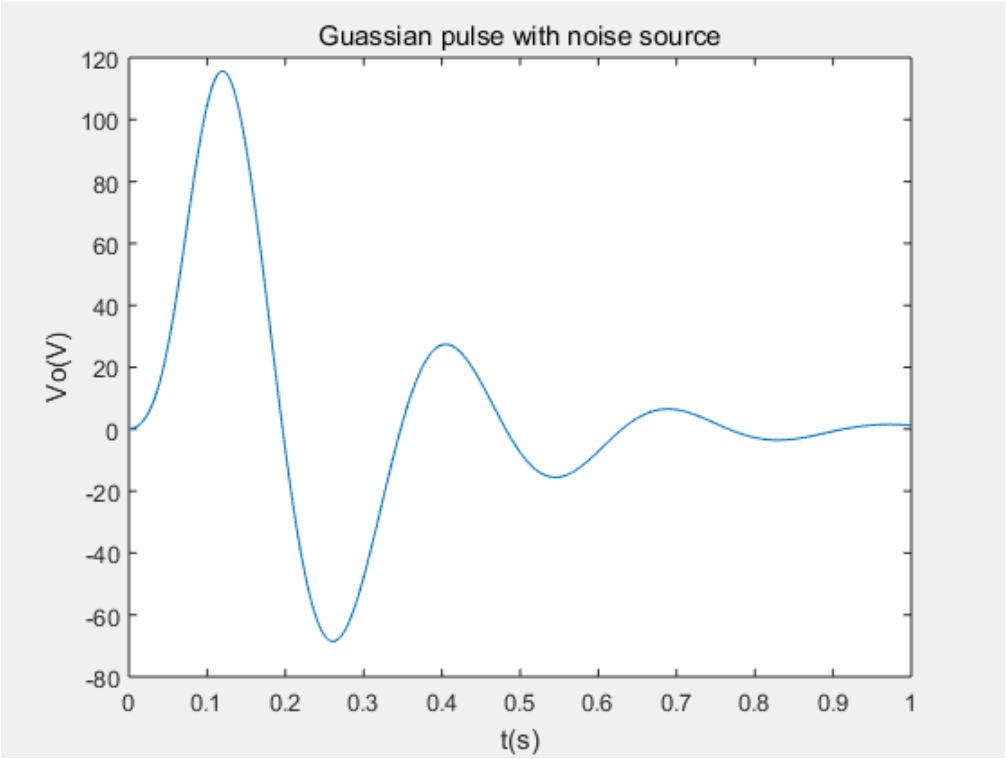
c) Fourier Transform plot



d) Vout with different Cn

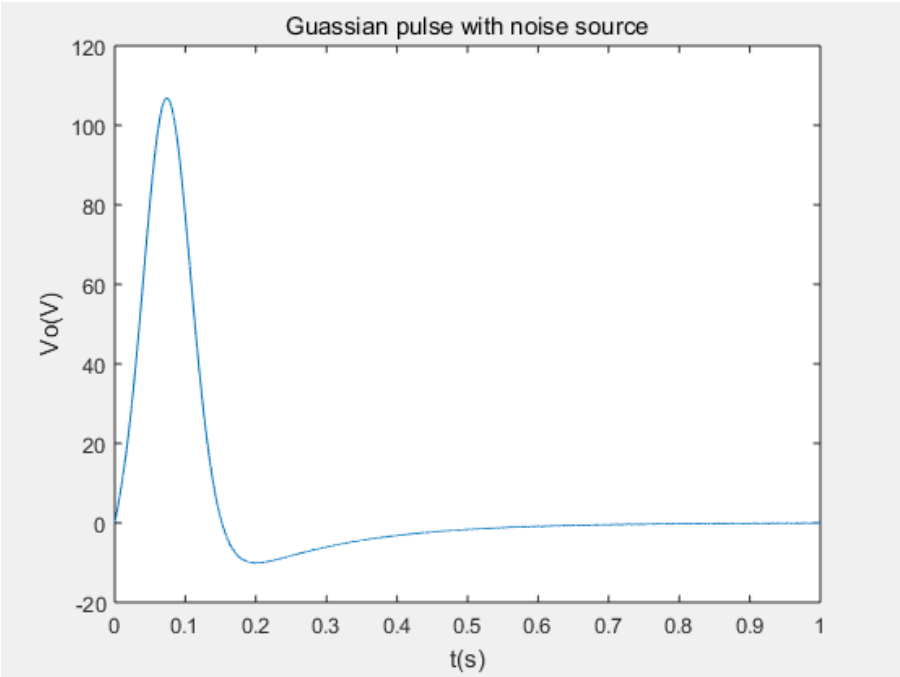


Vout vs t (Cn=0.001)



Vout vs t (Cn=0.01)

e) Vout with different time steps



Vout vs t (dt=0.0001)

Part 3 (i.e. question 4)

In this case, $V = \alpha I_3 + \beta {I_3}^2 + \gamma {I_3}^3$, we will need a B matrix so that the network of the circuit can be described by the following equation.

$$C\frac{dV}{dt} + GV + B = F$$