

2012

Iowa State University

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[EE 324 LAB REPORT #3]

Lab 3: Matlab functions, transfer functions and frequency domain analysis

Introduction

The objective of this lab is to analyze the circuit system using Laplace transform. This time we will derive the transfer function and analyze its frequency domain properties. Matlab functions as well as Simulink blocks will be used to analyze the system.

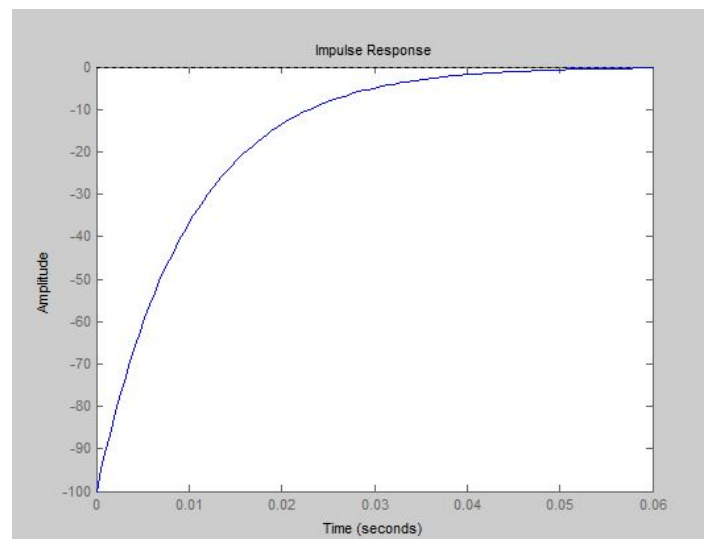
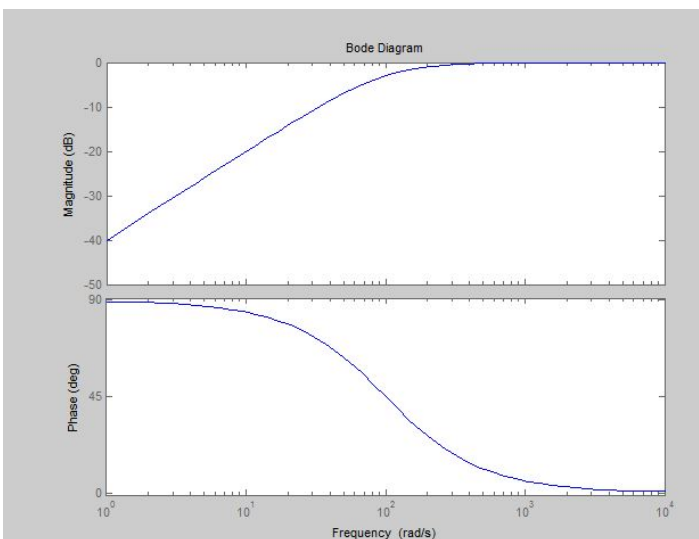
Steps

1. Use the Matlab functions `tf`, `pole`, `zero`, `residue`, `impz`, `step` and to verify the correctness of your analytical results from the pre-lab.
2. Using the transfer function, build an equivalent Simulink diagram.
3. Test the system to different input signals (impulse, step, sinusoids at various frequencies), observe the corresponding output, and verify that it is consistent with pre-lab analysis and with the output of the block diagram.

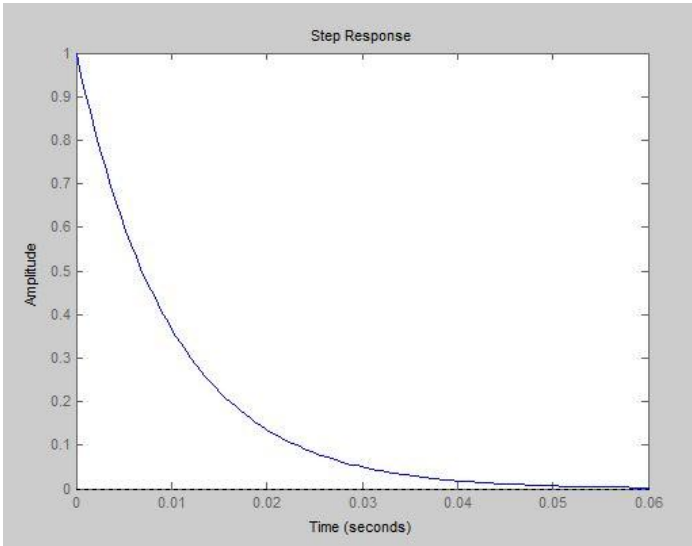
Lab Result

Matlab Result:

System a:



The diagram indicates that it is a high-pass filter.



```
pole_1 =
    -100

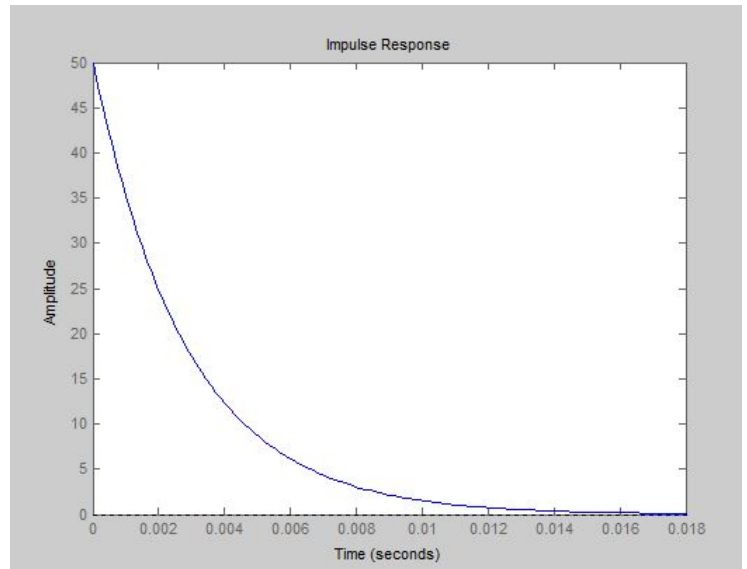
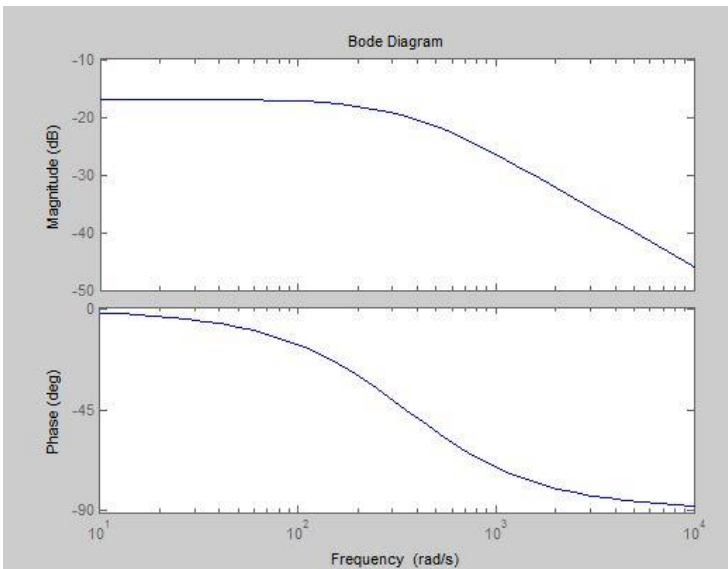
zero_1 =
     0

r =
    -100

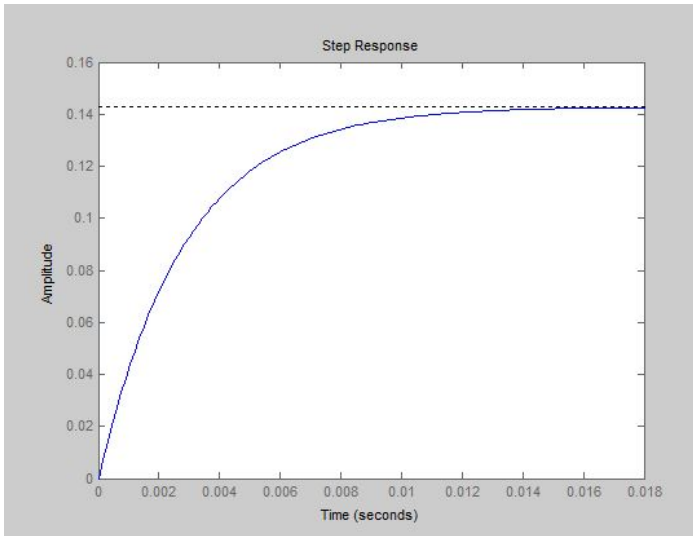
p =
    -100

k =
     1
```

System b:



The diagram indicates that it is a low-pass filter.



```
pole_1 =
    -350

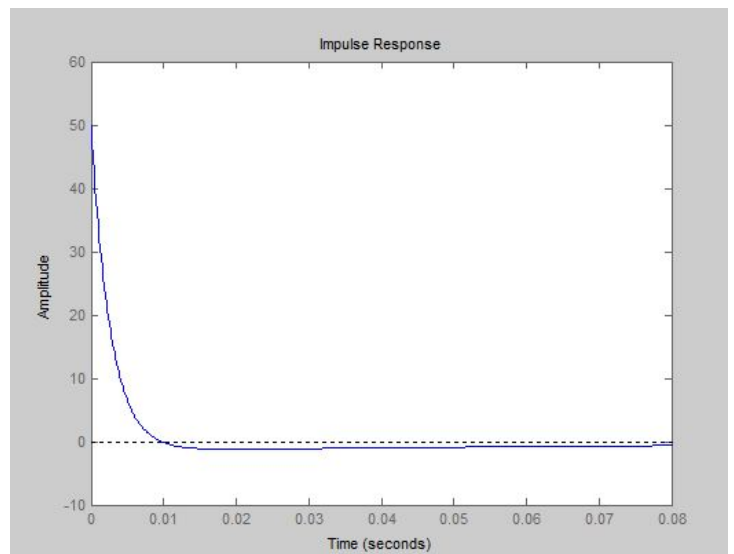
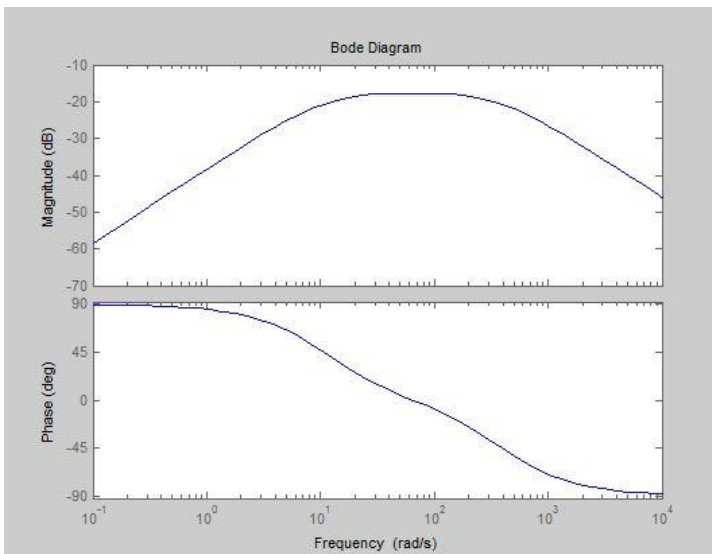
zero_1 =
    Empty matrix: 0-by-1

r =
    50

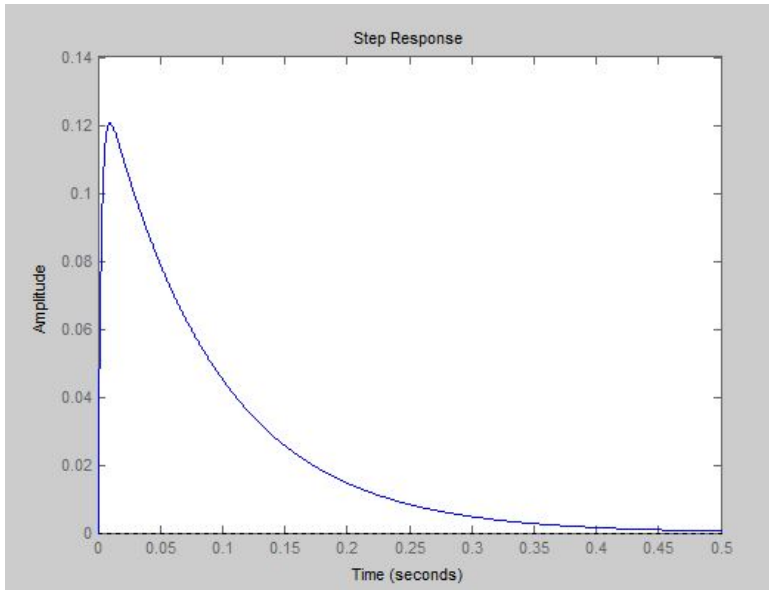
p =
    -350

k =
    []
```

System c:



The diagram indicates that it is a band-pass filter.



```
pole_1 =
    -372.1367
    -11.1966

zero_1 =
     0

>> Untitled

pole_1 =
    -372.1367
    -11.1966

zero_1 =
     0

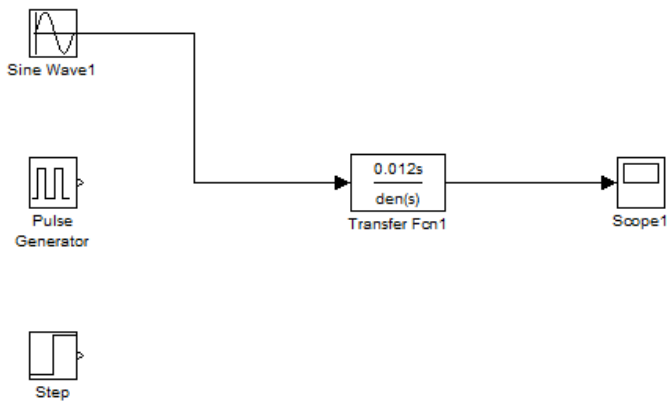
r =
    51.5510
    -1.5510

p =
    -372.1367
    -11.1966

k =
    []
```

Simulink Result:

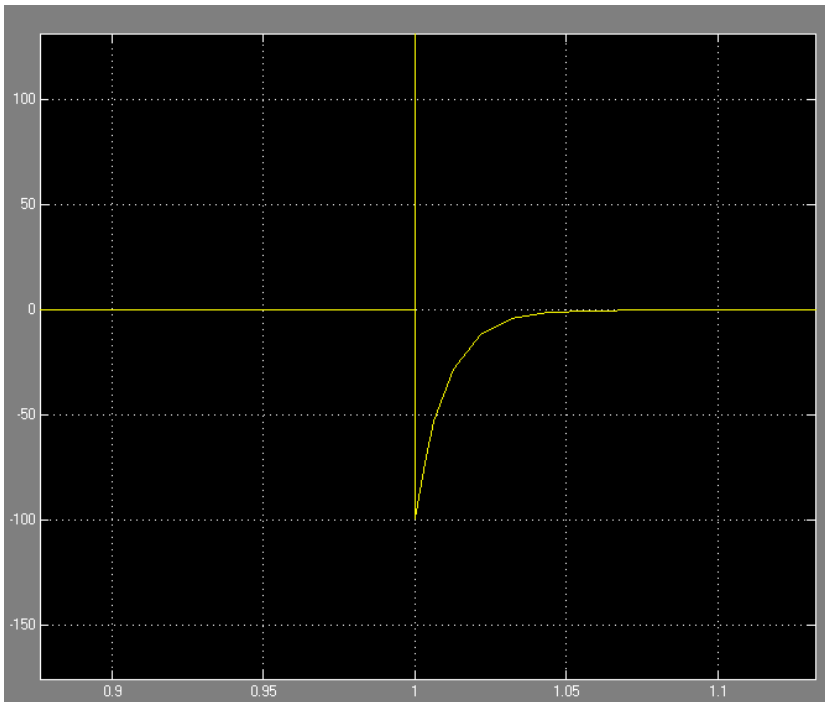
Block diagram:



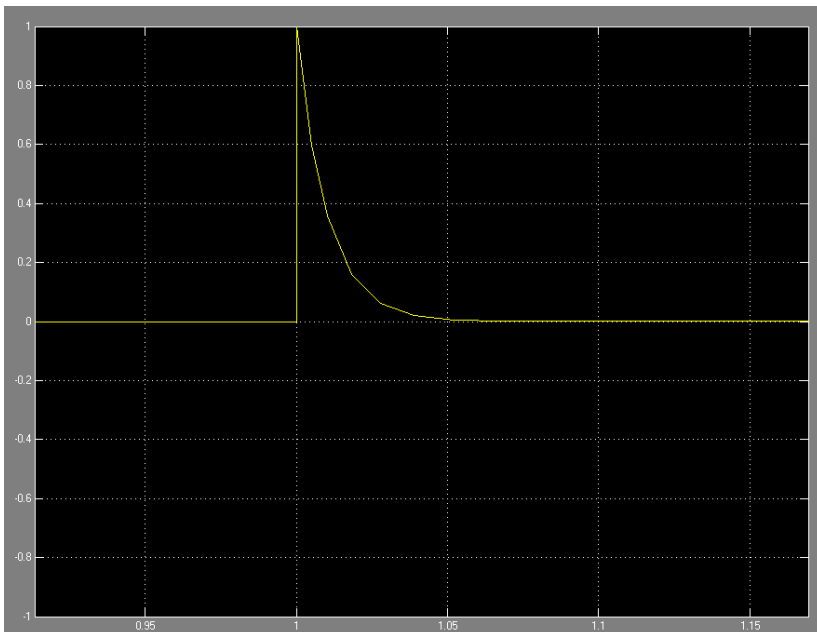
The block diagrams of the 3 systems are exactly the same except the transfer functions.

Output:

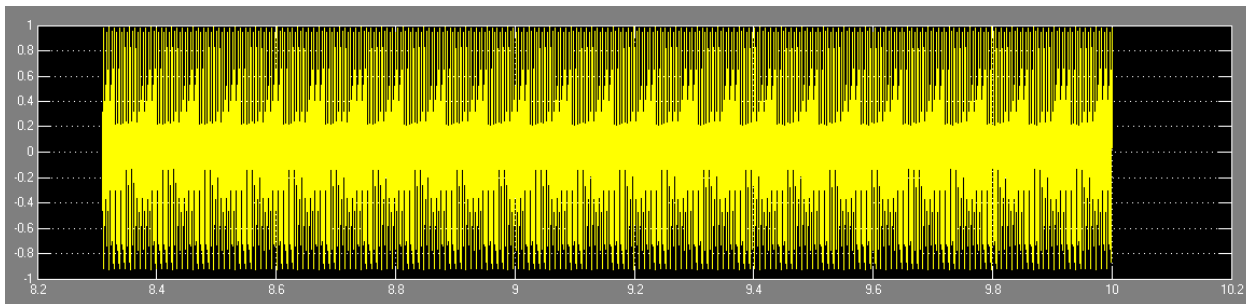
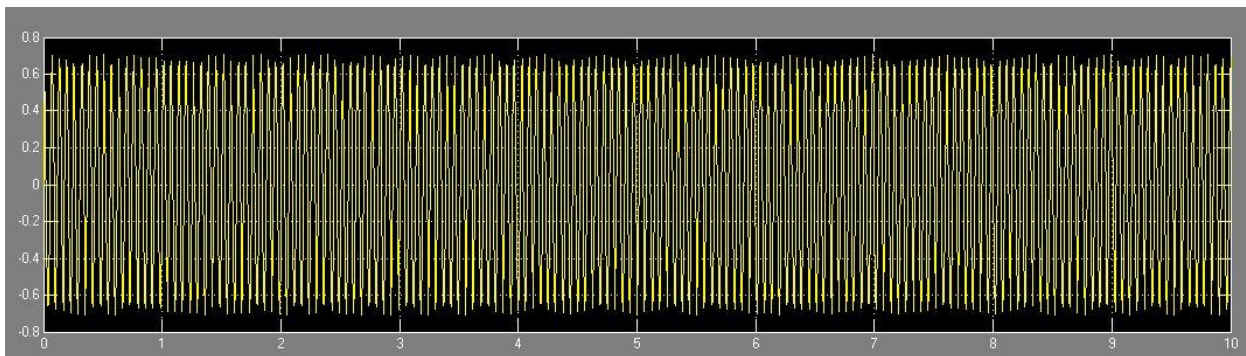
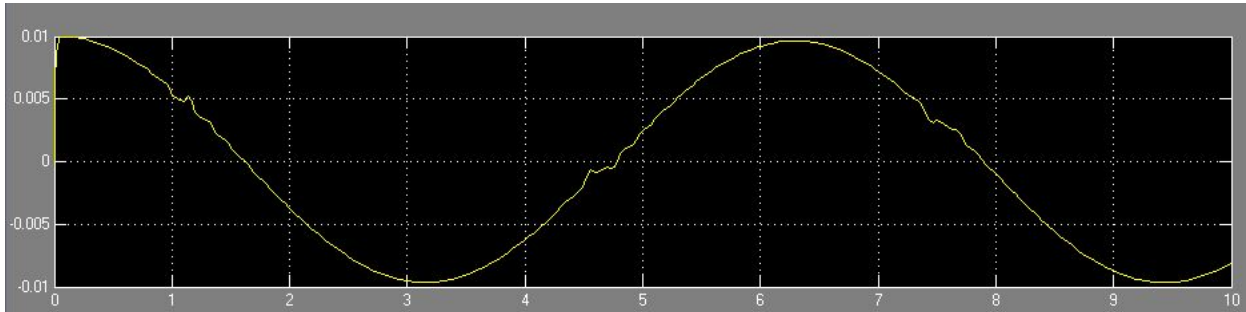
System a:



Impulse Response

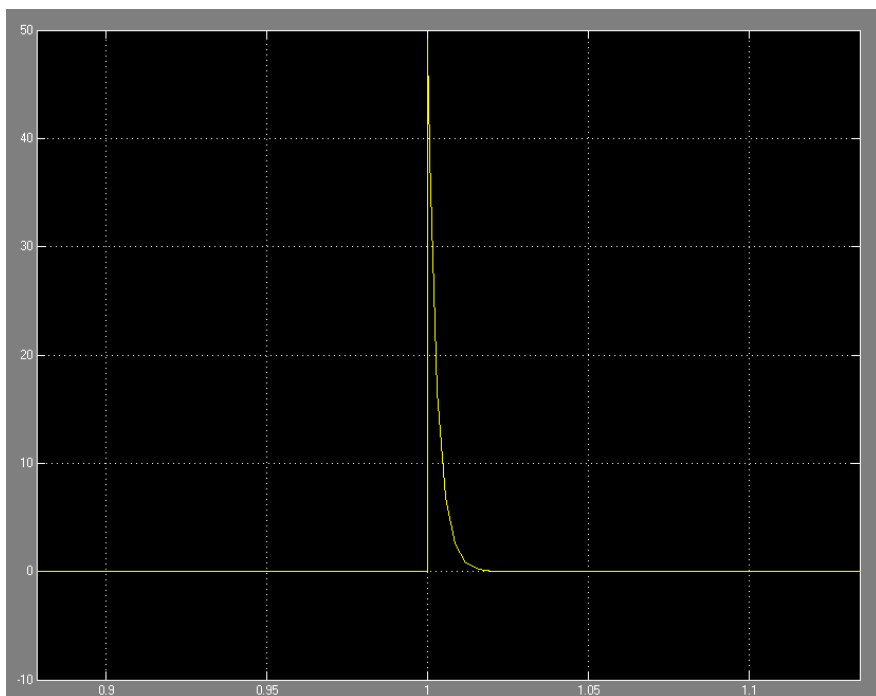


Step Response

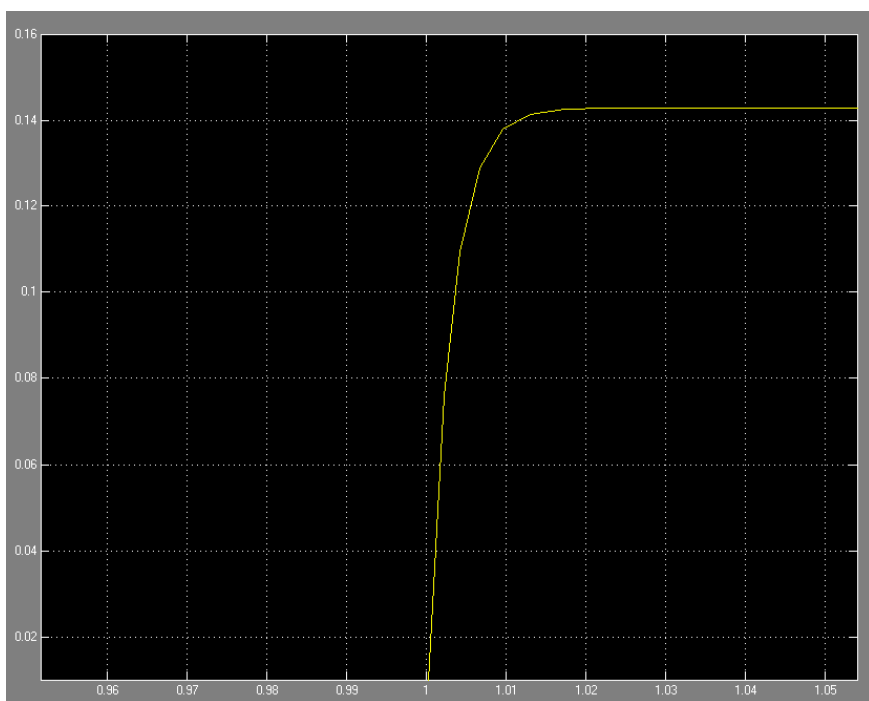


The frequency of the 3 sinusoid inputs are 1/10/100 Hz. We can see the amplitudes of the outputs are 0.01/0.7/1/.

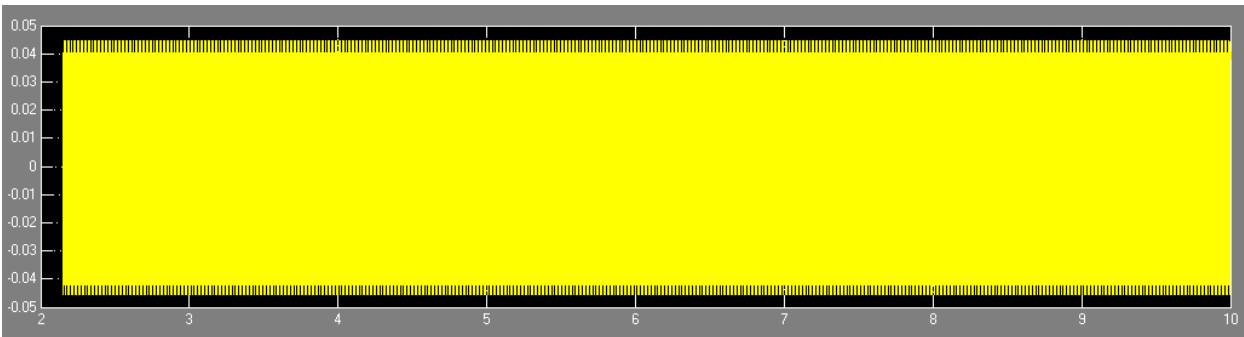
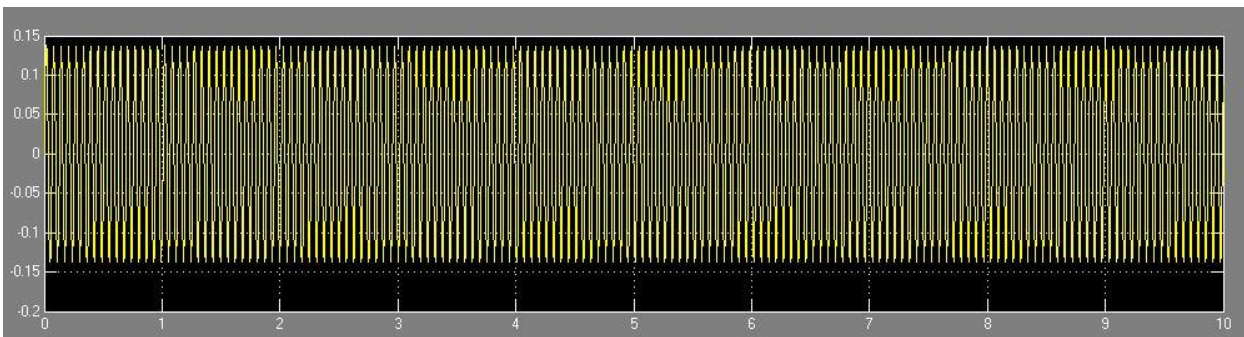
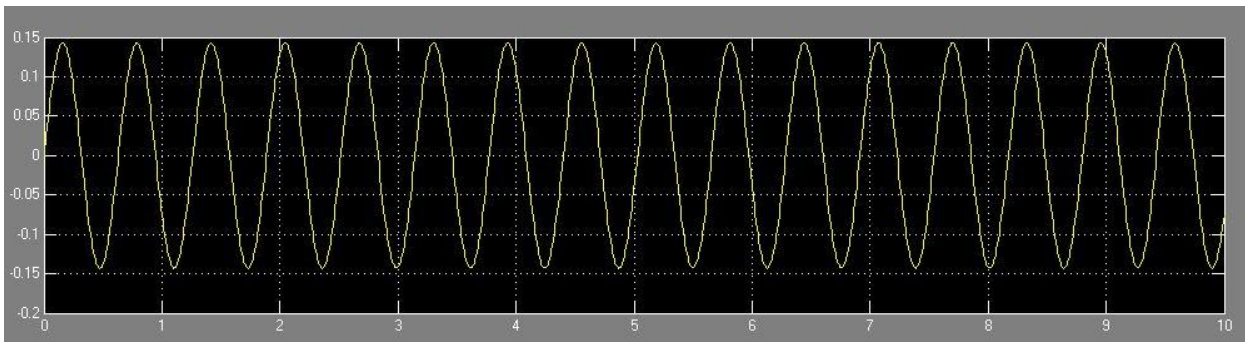
System b:



Impulse Response

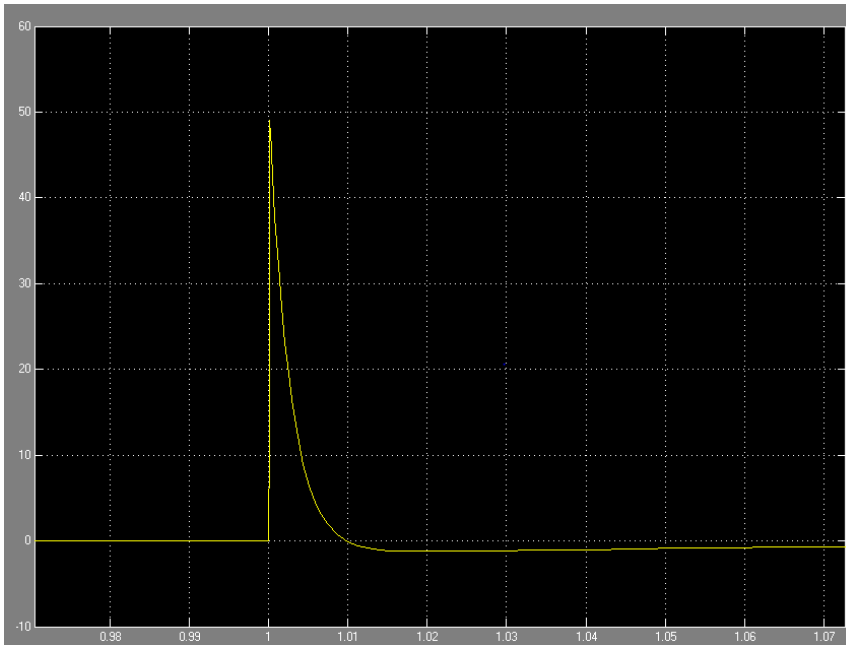


Step Response

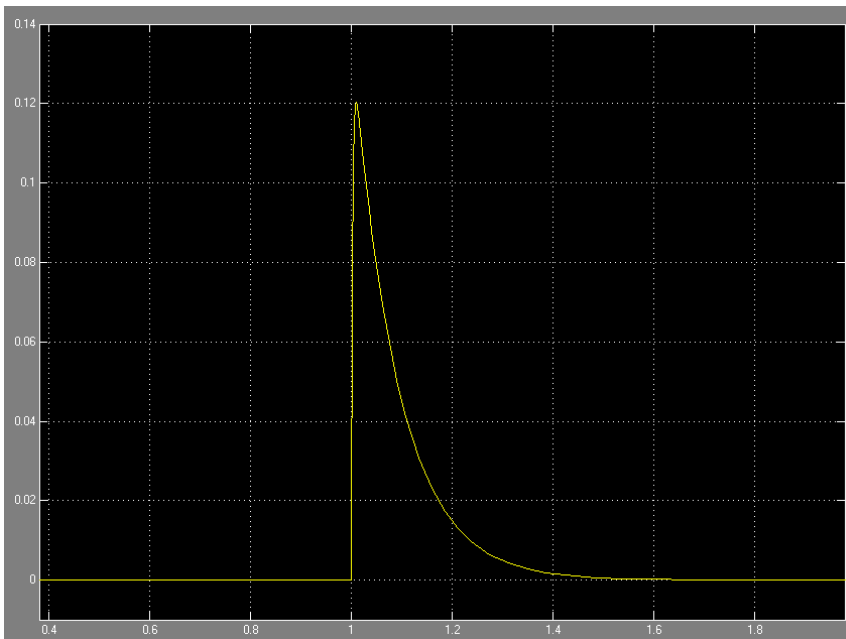


The frequency of the 3 sinusoid inputs are 10/100/1000 Hz. We can see the amplitudes of the outputs are 0.15/0.14/0.045/.

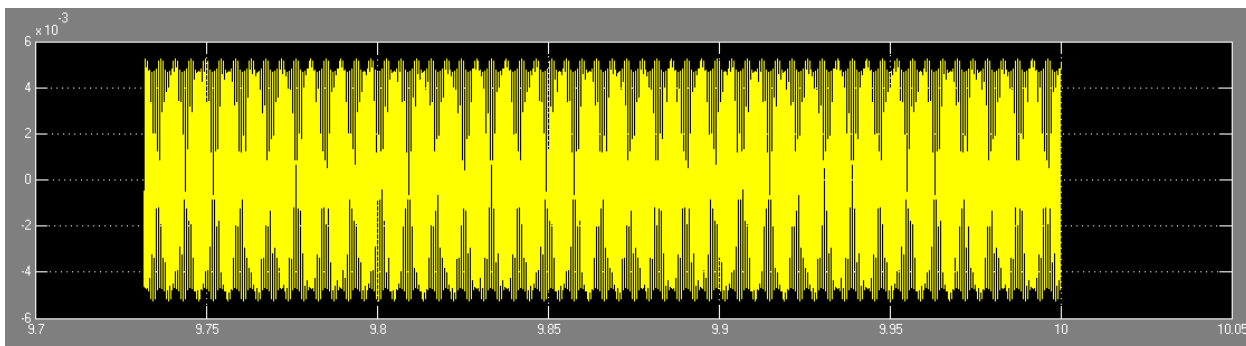
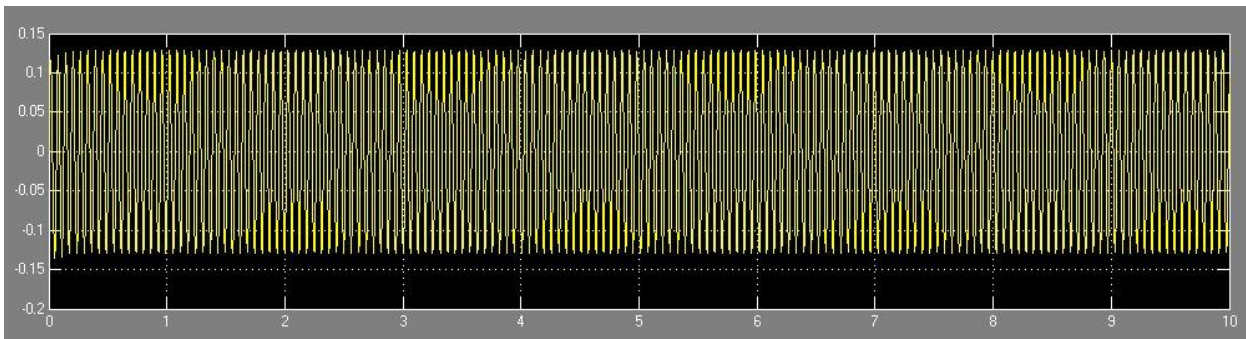
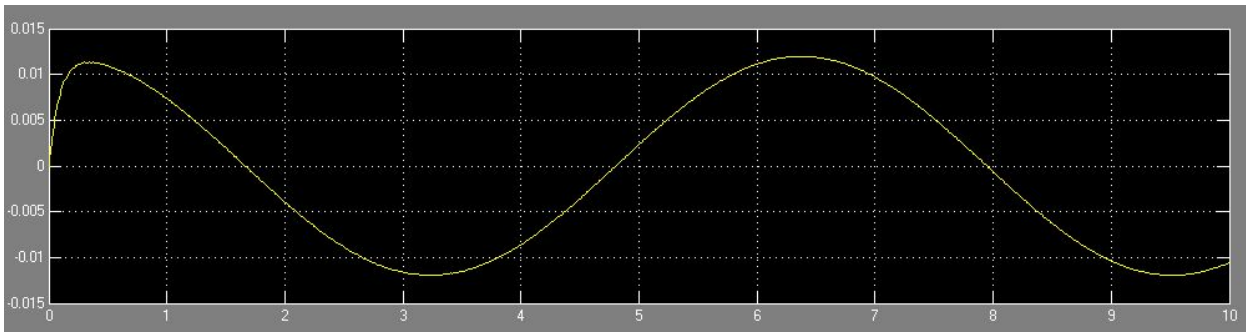
System c:



Impulse Response



Step Response



The frequency of the 3 sinusoid inputs are 1/100/10000 Hz. We can see the amplitudes of the outputs are 0.012/0.13/0.045/.

Analysis: according to the figures above, we can learn the results of the MATLAB functions and Simulink blocks are exactly the same. On the other hand, the magnitude value in Bode diagram is corresponding to the amplitudes of the outputs in different frequencies in Simulink.

Conclusion

In this lab we used both MATLAB functions and Simulink blocks to analyze a circuit system. The frequency domain properties, impulse response as well as step response are analyzed. From the figures we know that the results of both methods are the same and they are both effective methods.