LAB SESSION 6

MODELING COMMON PROBLEMS OF CONTROL SYSTEMS

OBJECTIVE

- To explore the use of LTIView in control systems simulation.

EQUIPMENT

- MATLAB / SIMULINK

PROCEDURE

LTIView:

'LTIVIEW' is used to create several plots to a Linear Time Invariant (LTI) system. The syntax for LTIVIEW is

ltiview(sys)

where 'sys' is a system model.

Various plots can be selected for viewing by right clicking on the current plot and then selecting 'plot type' and then clicking on the desired plot.

Find the transfer function (VL /V) of the following circuit using symbolic toolbox.

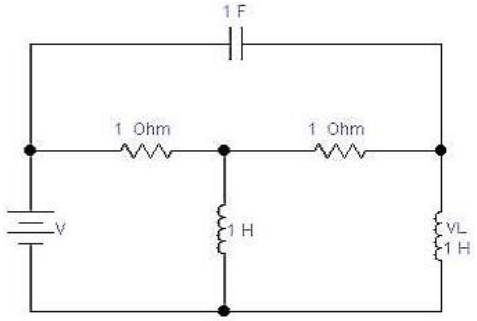


Figure 6.1: An Electrical Circuit

Once transfer function is determined, name it 'Gs'.

Following commands will convert symbolic object to transfer function object.

[numga,denga]=numden(Gs);

numga=sym2poly(numga);

denga=sym2poly(denga);

VL=tf(numga,denga)

Having found transfer function, enter

ltiview (VL)

The resulting window will show the step response considering output across inductor.

Step Response

Find.

1. Settling time
2. Rise time
3. Peak time
4. Steady State value.

Does the steady-state value match the expected value? _____

How impulse response can be found from the same command?

Explore LTI view.

Impulse response

Calculate transfer function if voltage is taken across capacitor.

Display VL and Vc using following command.

ltiview (VL,Vc)

Sketch Inductor and Capacitor voltages below and identify them on graph.

Inductor Voltage

Capacitor Voltage

Write your comments on the above plots.

.....
.....
.....
.....
.....

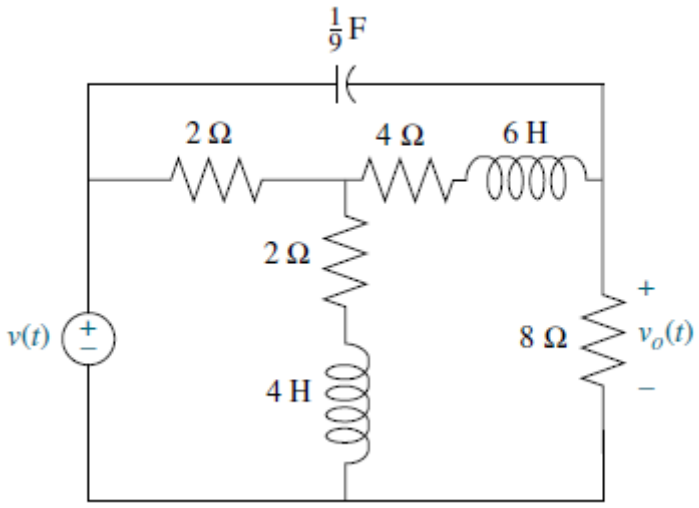


Figure 6.2: An Electrical Circuit

Fid the transfer function $V_o(s)/V(s)$ by following the steps in the first question

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....

Find the step response using the command ltiviewshow the characteristics of the graph Peak response, Settling time, Rise time and Steady state.Locate the Poles and Zeros using Pole /Zero plot option.

Step Response

Impulse response

Let's find state-space model for the following circuit. Here, notice that there are two outputs, one capacitor voltage and other inductor voltage.

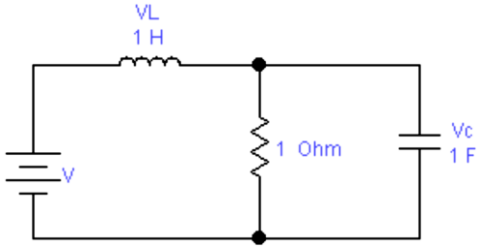


Figure 6.2: An Electrical Circuit with two outputs

Here are required matrices.

A= [0 -1; 1 -1];

B= [1 ; 0];

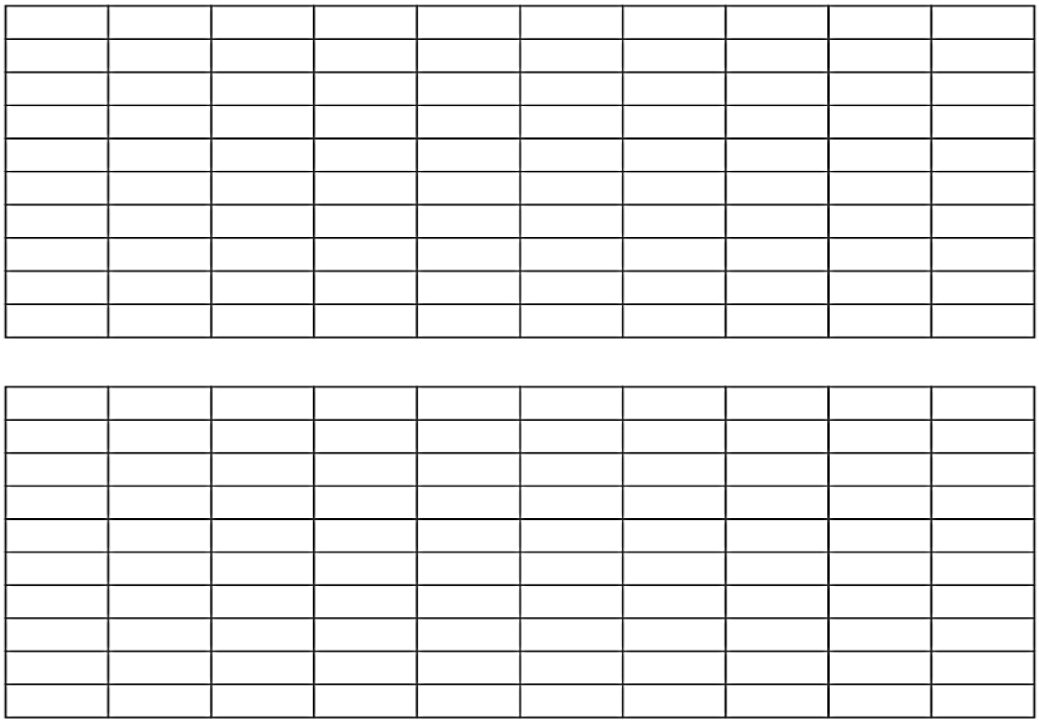
C= [0 -1; 0 1];

D= [1 ; 0];

State-space model ‘sys’ is

sys=ss(A,B,C,D);

ltiview(sys)



Outputs V_c and V_L

Find

1. Settling time
2. Rise time
3. Peak time
4. Steady State value

Also Settling Time is set for 2% definition. Can you change it for 10%? [Hint: right click on graph and explore properties.]

Compare settling time for 2% and 10% values. Write your comments

.....
.....
.....
.....
.....

Similarly, by default, Rise Time definition is set for 10% to 90%. Change it to 5% to 95% and compare results.

.....
.....
.....
.....
.....
.....
.....
.....

There are many more features are provided by LTI view, which you need to explore by yourself.

Modeling Multiple Output Systems

Consider the following electrical circuit. If the output is taken across R1, find the state space representation.

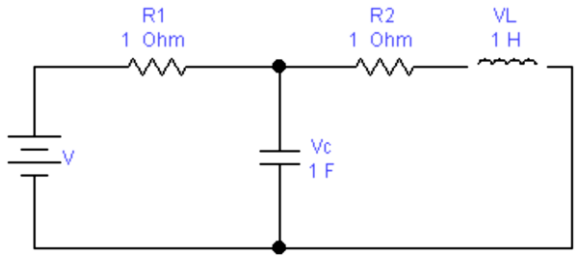


Figure 6.3: An Electrical Circuit

Required Matrices are:

A = [-1 -1; 1 -1];

B = [1; 0];

C = [-1 0];

D = [1];

Use the following model to analyze step response of the above state-space model:

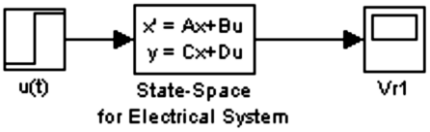


Figure 6.4: Model to analyze step response of the above state-space model

V_{R1}

Now, if we want four outputs, voltage across every component. Required C and D matrices as below.

C = [-1 0; 0 1; 1 0; 1 -1];

D = [1; 0; 0; 0];

Verify these matrices from calculations. Will A and B matrices change? Why or Why not?

Model becomes

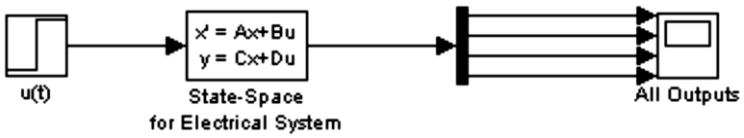


Figure 6.5: A model for four outputs

Identify each output (V_C, V_L, V_{R1}, V_{R2}) and sketch them below.

V_C										
V_L										
V_{R1}										
V_{R2}										