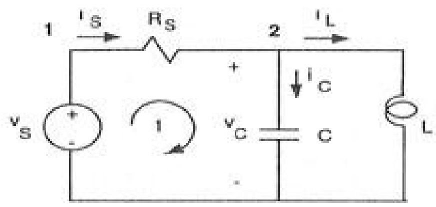
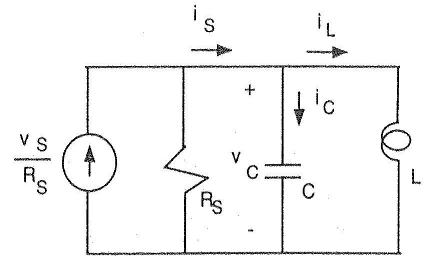
Title of the Exercise: Parallel RLC Circuit

Date: 4.9.2020

Aim: To Simulate the dynamic model of a RLC circuit and plots Voltage and current at various terminals and also analyze theoretical results.

Tool used: MATLAB





Electrical Circuit:

Parameters used for the study:

Input: Rs = 50ohm, L = 0.1H, C = 1000e-6F, V=100 Volts

Theoretical Analysis: It's a transient circuit with a current source. We use transient circuit analysis to determine the values of current and volaage for the capacitor and inductor.

Calculations (Predetermination):

Theoretical Analysis

Given. $R = 50\,\Omega$, $L = 0.1\,H$, $C = 1000\times10^{-6}\,f$

$V = 100\,V$

$$\omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{0.1\times\left(\frac{1}{1000}\right)}} = 1000$$

$$\alpha = \frac{1}{2RC} = \frac{1\times1000}{2\times50} = 10$$

$$\omega_0 > \alpha, \Rightarrow \omega = \sqrt{100^2 - 10^2} = 99.5$$

V_c can be expressed as

$$V_c = e^{-\alpha t}(B_1 \cos\omega t + B_2 \sin\omega t)$$

$$V_c(0) = 0 = B_1$$

$$\Rightarrow B_1 = 0 \,//$$

differentiating V_c w.r.t t

$$\frac{dV_c}{dt} = -10e^{-10t}(B_1 \cos 99.5t + B_2 \sin 99.5t)$$
$$+ 99.5\times e^{-10t}(-B_1 \sin 99.5t + B_2 \cos 99.5t)$$

at $t = 0$ $\quad \left.\frac{dV_c}{dt}\right|_{t=0} = \frac{i_c}{c} = 2000 \qquad \left|\, i_c = c\frac{dV_c}{dt}\right.$

$$\left.\frac{dV_c}{dt}\right|_{t=0} = -10B_1 + 99.5(-B_1 + B_2) \qquad |\, B_1 = 0$$

$$B_2 = 20.10$$

$$V_c = (20.1 \sin 99.5t)\, e^{-10t}$$

$$V_L = (20.1 \sin 99.5t)\, e^{-10t}$$

Solving for other values, we will get

$$i_s(t) = 2 - 0.401\, e^{-10t} \sin 99.5t$$

$$i_L(t) = 2t\, e^{-10t} (-2 \cos 99.5t - 0.201 \sin 99.5t)$$

$$i_c(t) = e^{-10t} (2 \cos 99.5t - 0.201 \sin 99.5t)$$

Procedure for simulation study:

Step1-Initialize the input parameters and write coding for the as per requirement of plots in m file and save it.

Step 2-open new Simulink and make mathematical modelling as per circuit diagram and save it.

Step 3-Run the m file first ,after that run Simulink file.

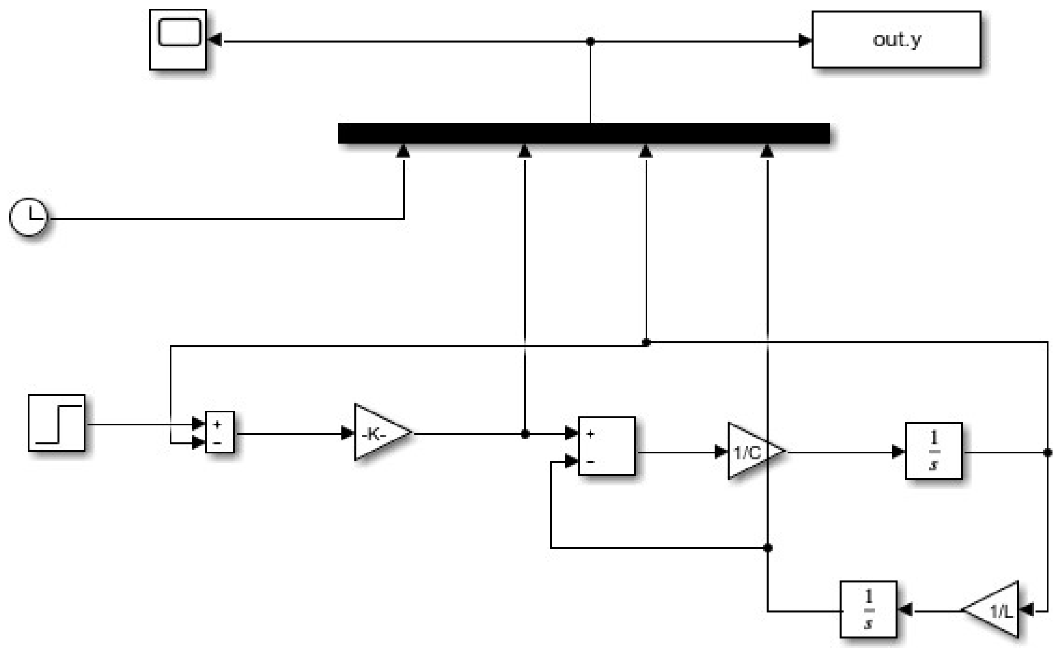
Step 4 -View the result in Scope.

Step 5- Again run m file and view the plots.

Step 6-Make various plots and write the Results.

Simulation Diagram and m.file coding :

Simulation rendered wave form:-

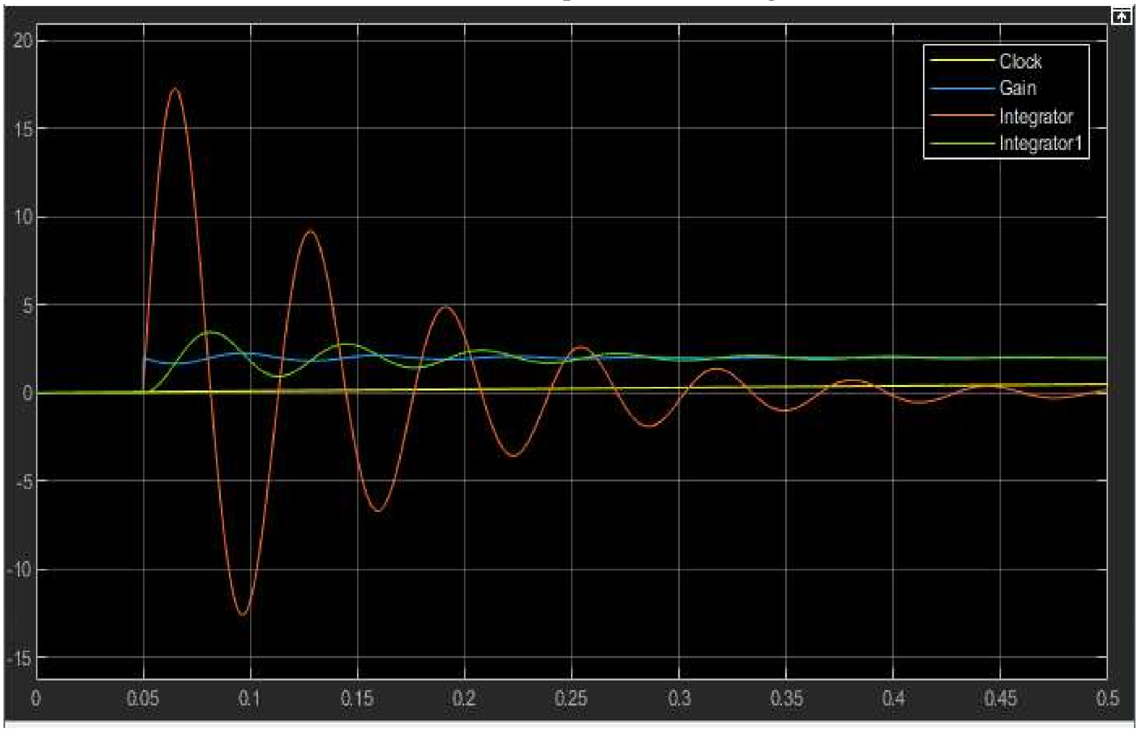


M.file coding:

```
Rs = 50;
L= 0.1;
C= 1000e-6;
vS= 100;
tdealy= 0.05;
vCo= 0;
iLo= 0;
tstop=0.5;
disp('run simulation')
keyboard
%plot(figsize(10,6))
subplot(3,1,1)
nexttile
plot(out.y.signals.values(:,1),out.y.signals.values(:,2),'b--o')
title('source current')
ylabel('is in Amp')
nexttile
plot(out.y.signals.values(:,1),out.y.signals.values(:,3),'g.')
title('capacitor voltage')
ylabel('vC in volts')
nexttile
plot(out.y.signals.values(:,1),out.y.signals.values(:,4),'y--o')
title('inductor current')
ylabel('iL in Amp')
xlabel('time in secs')
%set(gcf,'position',[0,0.1,400,600])
```

Results and Discussions:

This section contains both waveforms with respect to time along with the theoretical value.



Simulation rendered waveforms

Comparison (Observations):

Time	Theoretical Value(Ic)	Simulation(Ic)	Theoretical Value(V_c)	Simulation(V_c)
0	2	2	0	0
0.5	0.007673	0.007673	0.10337	0.10337
0.25	0.142	0.14199	0.6940	0.6940
0.025	1.5493	1.5493	0.6794	0.6794

Conclusion: The theoretical value is the same as the simulation results.

Inference: The analysis of the parallel RLC circuit dynamic model provides the following inferences:

- As the time increases, after a ertain amount of time the vlaue of capacitor voltage and inductor current doesnt change
- The value of omega is less than the value of alpha therefore it is a critically underdamped circuit.

Reference:NIL