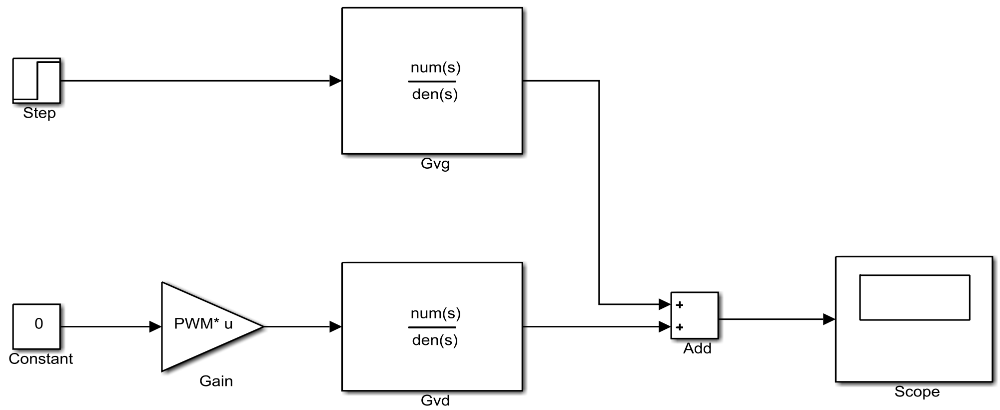
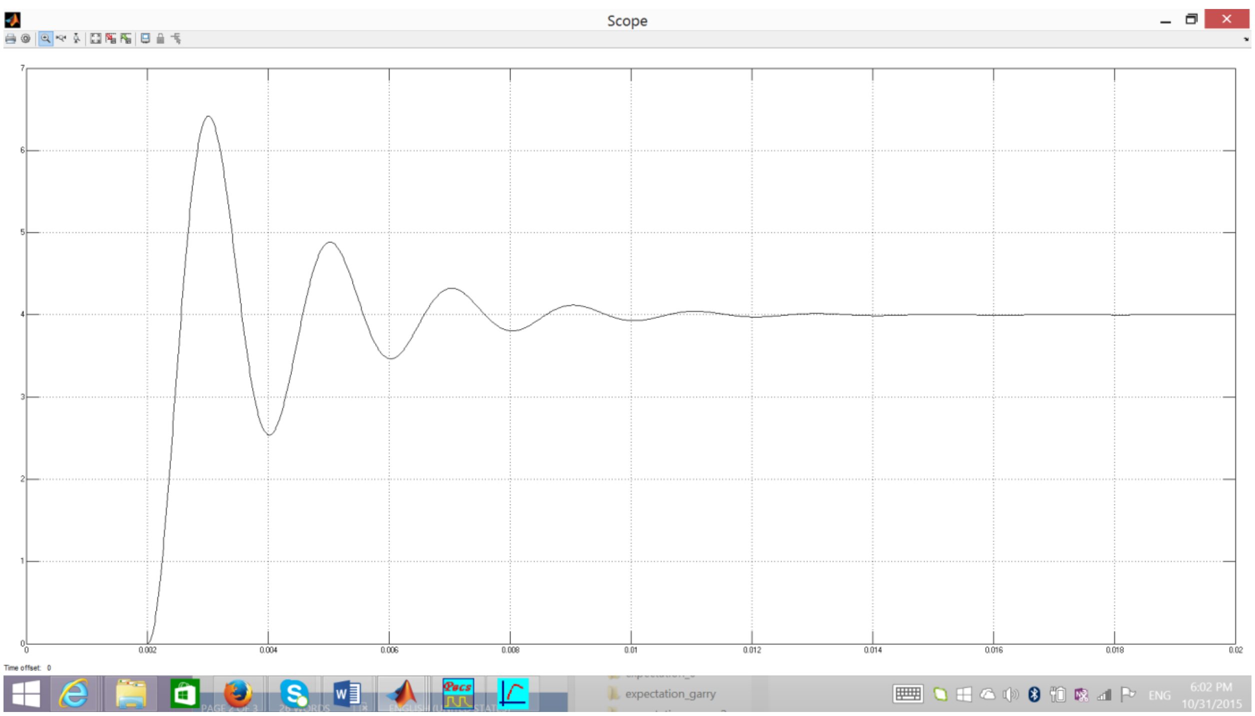
ECE311 Project Part 1

SIMULINK:

% Matlab script

```
close

R=10;
L=1e-3;
C=100e-6;
D=0.4;
Vg=100;
Vm=2;
s = tf('s');

%%%%%%%%%%%%%%%%%%%%%%%%%%

w0=1/sqrt(L*C);
Q=R/L*sqrt(L*C);
del=1+s/(w0*Q)+(s/w0)^2;

Gvd = Vg/del;
Gvg= D/del;
PWM = 1/Vm;
```


Step
num(s)
den(s)
Gvg
0
Constant
PWM* u
Gain
num(s)
den(s)
Gvd
+
+
Add
Scope


Scope
7
6
5
4
3
2
1
0
0
0.002
0.004
0.006
0.008
0.01
0.012
0.014
0.016
0.018
0.02
Time offset: 0

Overshoot:

Simulink model is an incremental (small-signal) model. So the initial zero level is the steady state level before application of the disturbance. This represents a level of 40V.

After the disturbance the peak level from inspection of the above plot is 6.5V which represents a 46.5V peak.

The steady state after the disturbance is 40 + 4 = 44V

Thus the overshoot = (46.5 – 44)/44 * 100 = 5.7%

5% Settling Time:

1.05 * 44 = 46.2 V

0.95 * 44 = 41.8 V

➔ From plot we see it settles to within 5% at 46.2 V at time 0.0033.

The step is applied at time 0.002s therefore the

settling time = 0.0033 – 0.002 = 0.0013 = 1.3ms

Rise Time:

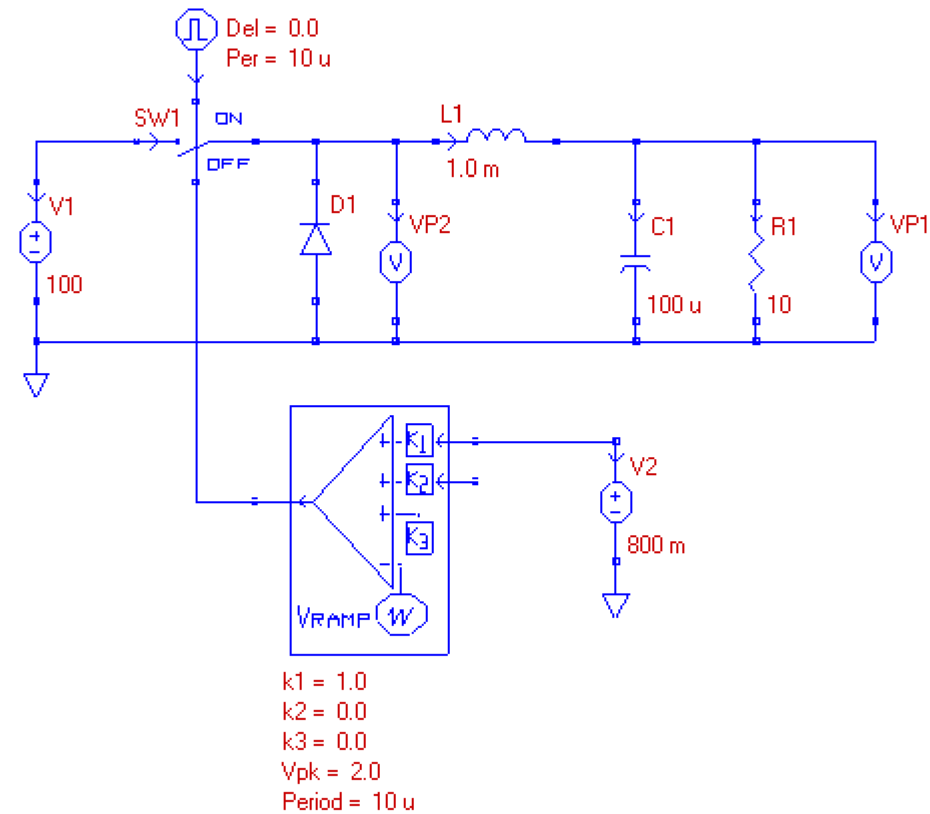
For incremental model final value = 4V ➔

0.1 * 4 = 0.4V

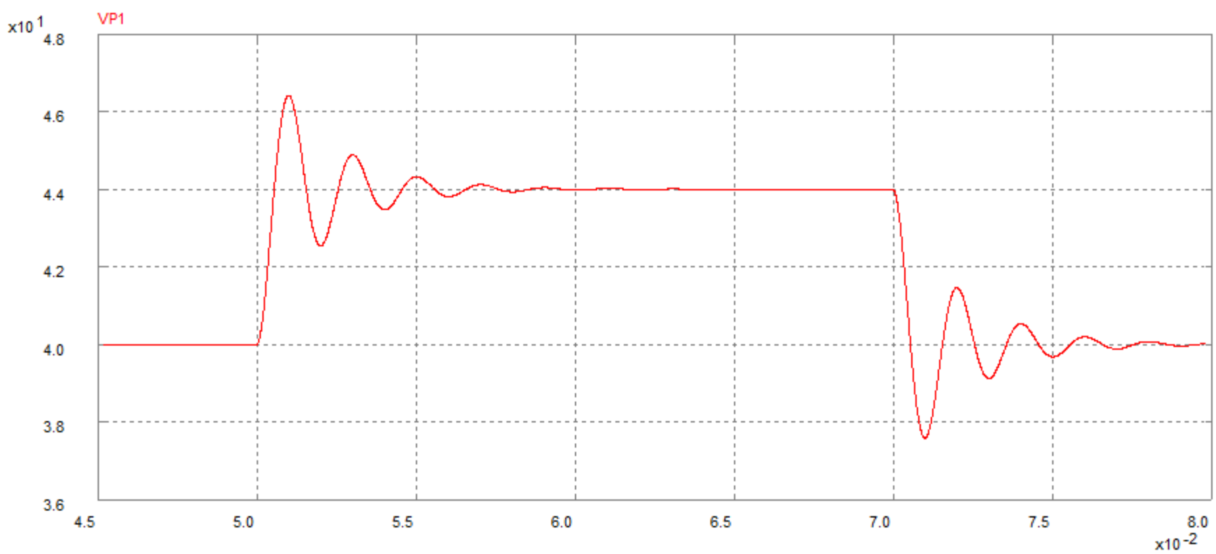
0.9 * 4 = 3.6V

➔ Rise time from 0.4V to 3.6V from plot = 0.0004 = 0.4ms

PECS:



Del = 0.0
Per = 10 u
SW1
ON
OFF
L1
1.0 m
V1
100
D1
VP2
C1
100 u
R1
10
VP1
V2
800 m
VRAMP
k1 = 1.0
k2 = 0.0
k3 = 0.0
Vpk = 2.0
Period = 10 u



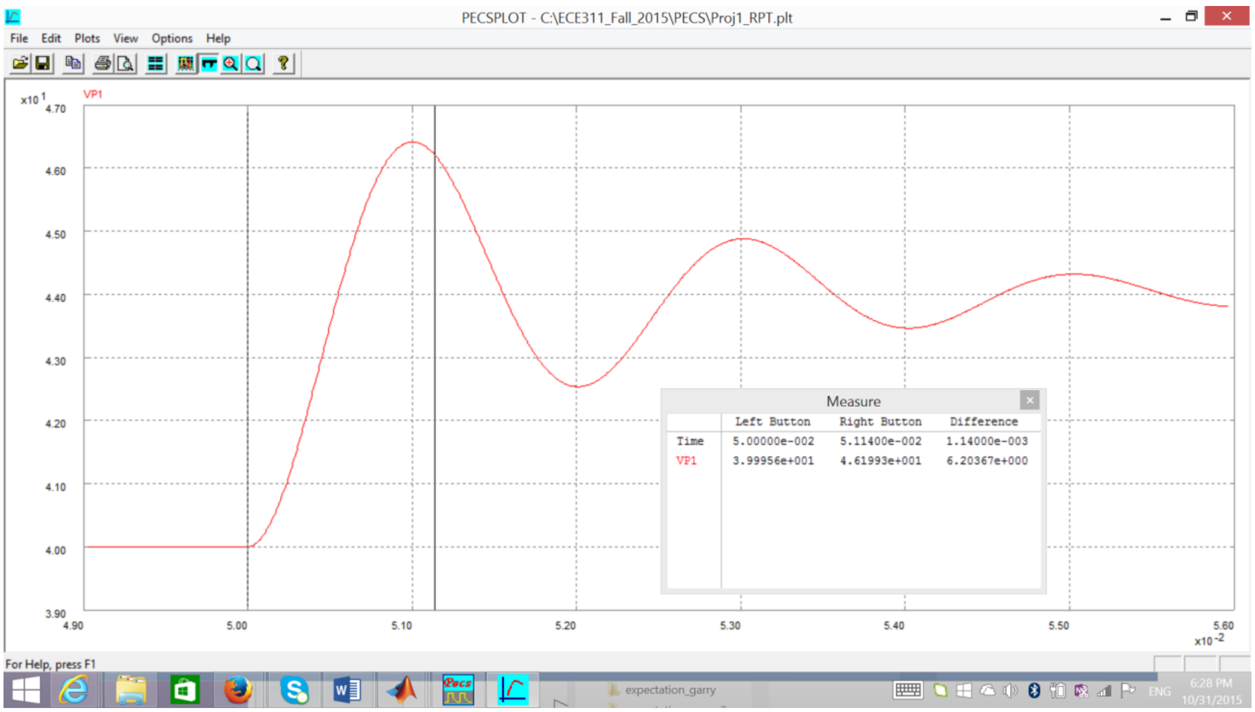
VP1
x10 1
4.8
4.6
4.4
4.2
4.0
3.8
3.6
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
x10 -2

Overshoot:

Peak = 46.5V

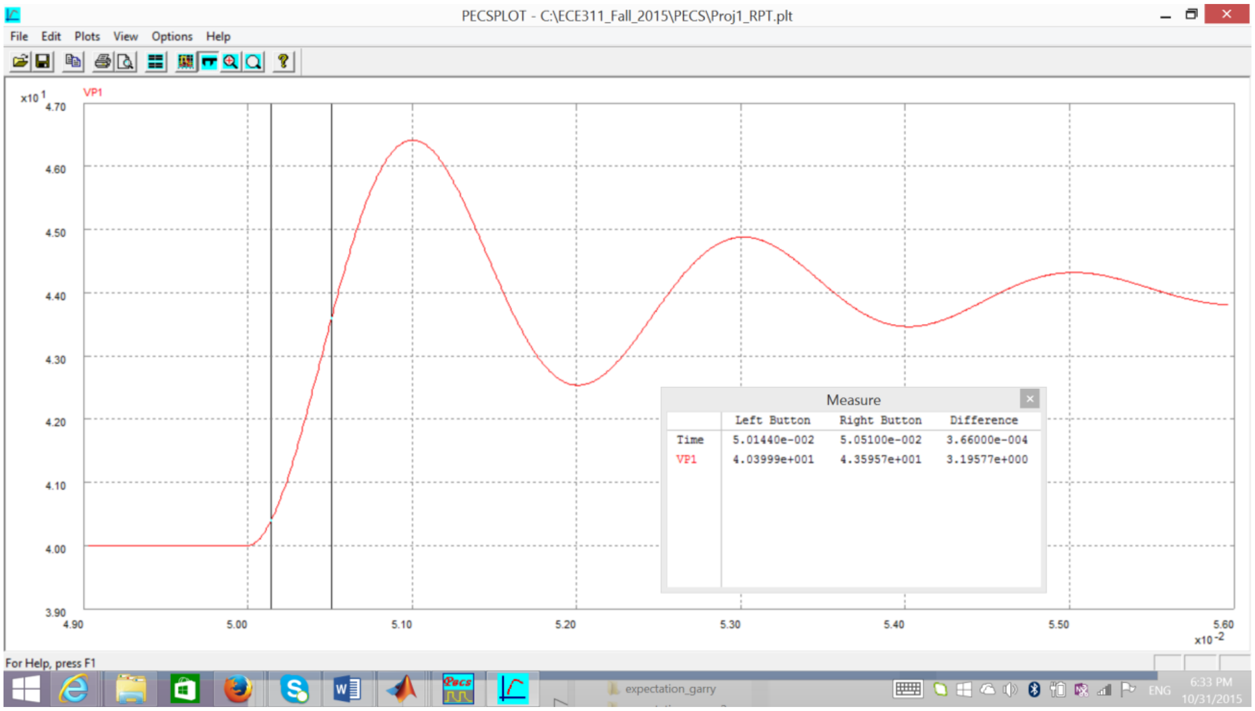
Steady state after disturbance = 44V

% Overshoot is the same as for the Simulink = 5.7%



Settling Time:

From the above plot the 5% settling time = 1.14 ms



Rise Time:

10% value = 40 + 0.1*4 = 40.4V

90% value = 40 + 0.9*4 = 43.6V

The time to go from 40.4V to 43.6V from the above plot gives we see the rise time = 0.37ms

Summary:

	Simulink	PECS
% Overshoot	5.7 %	5.7 %
5% Settling Time	1.3 ms	1.14 ms
Rise Time	0.4 ms	0.37 ms

Agreement between simulators is good and would probably be improved with more accurate determination of the values from the Simulink plot.