Computer Assignment #1

Class: ECE2101 Section 3

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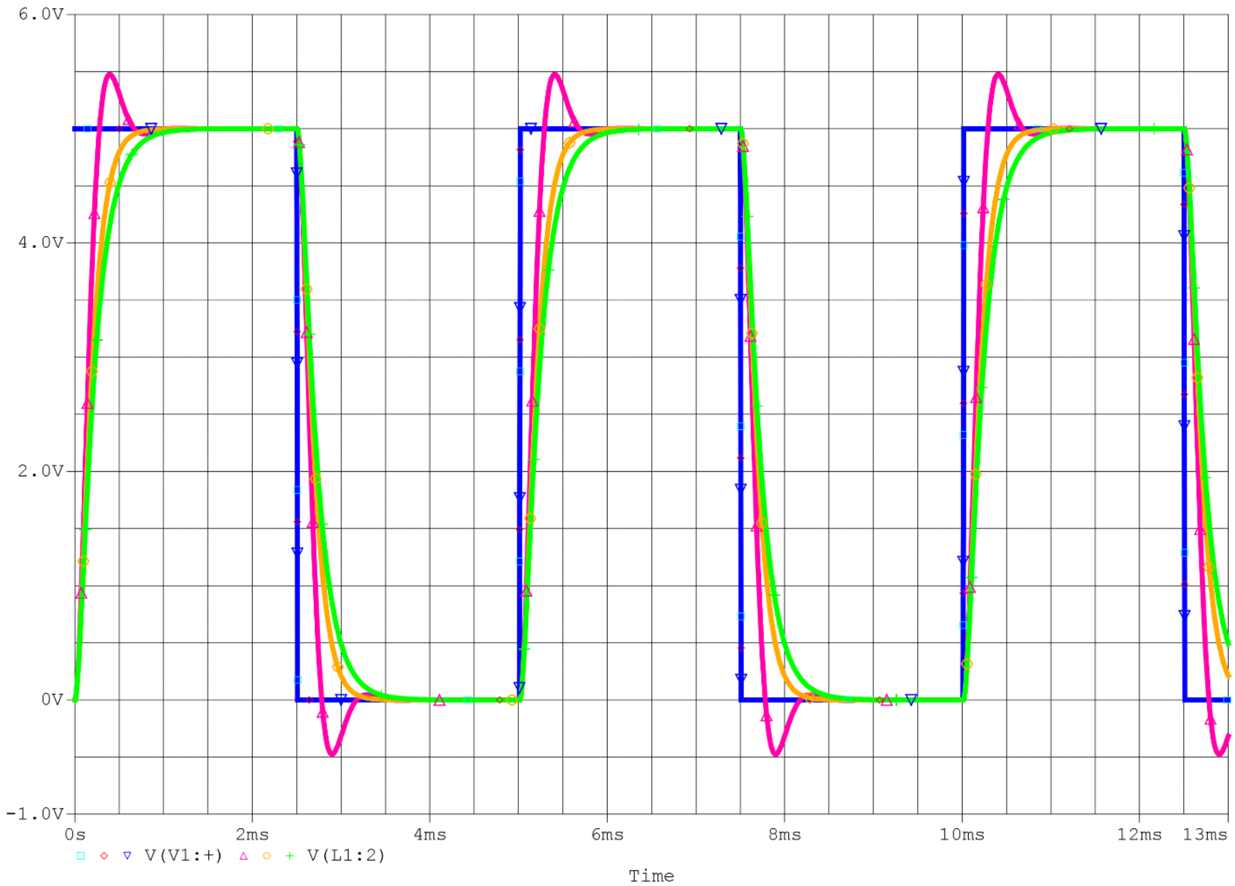
Objective:

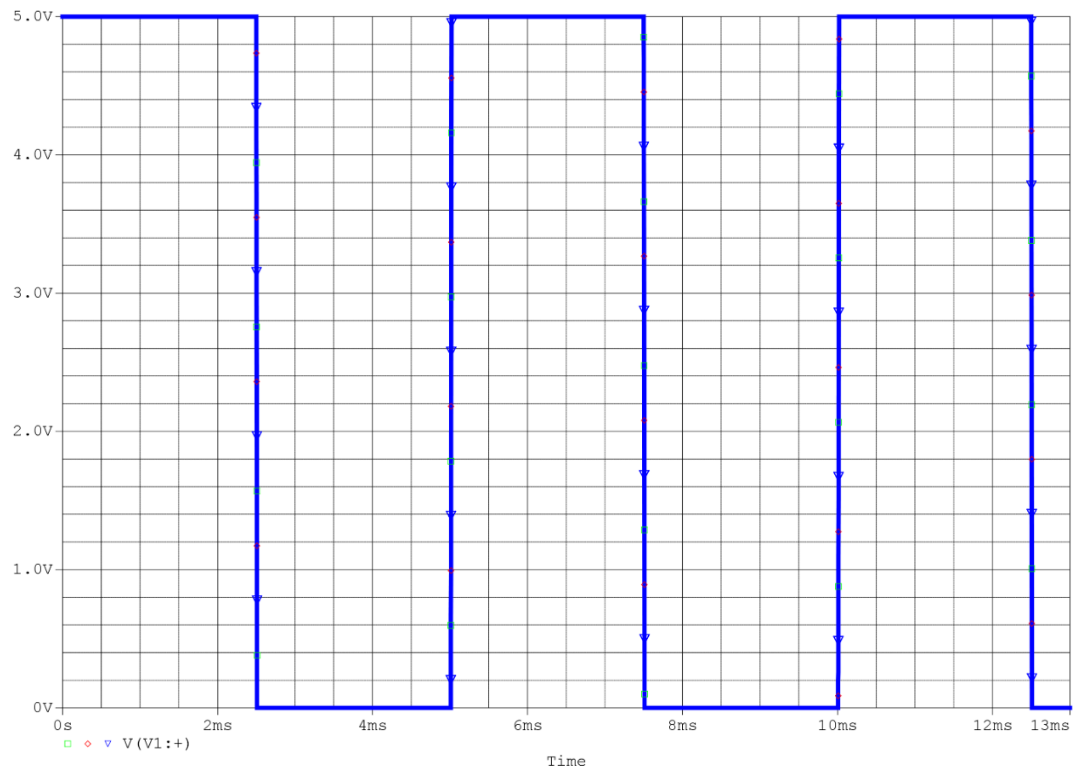
The objective of the computer assignment is for students to get practice in creating circuits in PSPICE. The circuits created use both periodic and DC voltage sources along with switches and parametric sweeps. Then students would need to be able to find the responses of various components in the circuits.

Results:

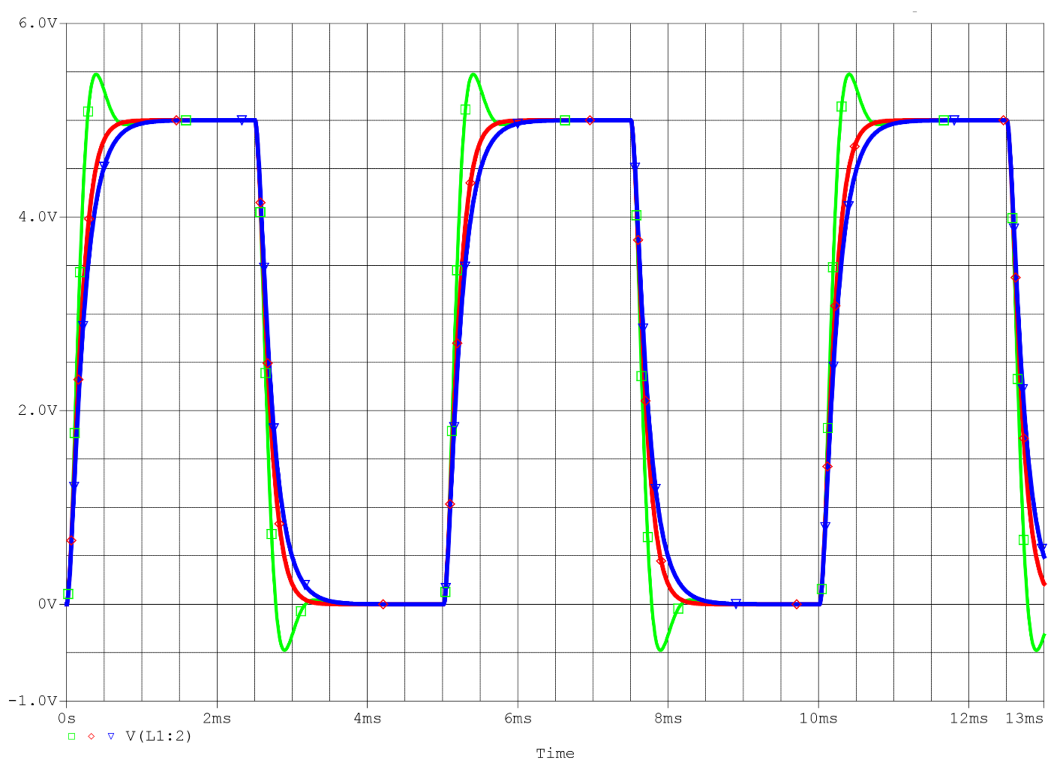
Problem 1:



Graph 1: Plot of vg(t) and vc(t) when R = 750, 1250, and 1500 for 0<= t<=13ms

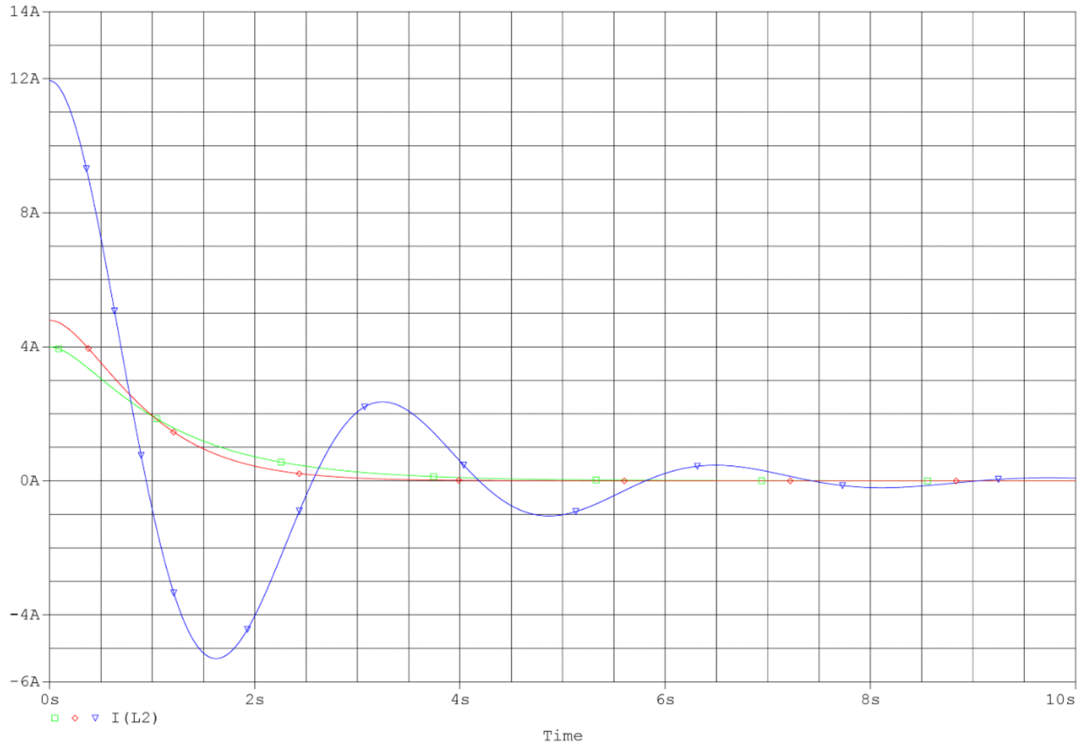


Graph 2: Plot of vg(t) when R = 750, 1250, and 1500 for 0<= t<=13ms

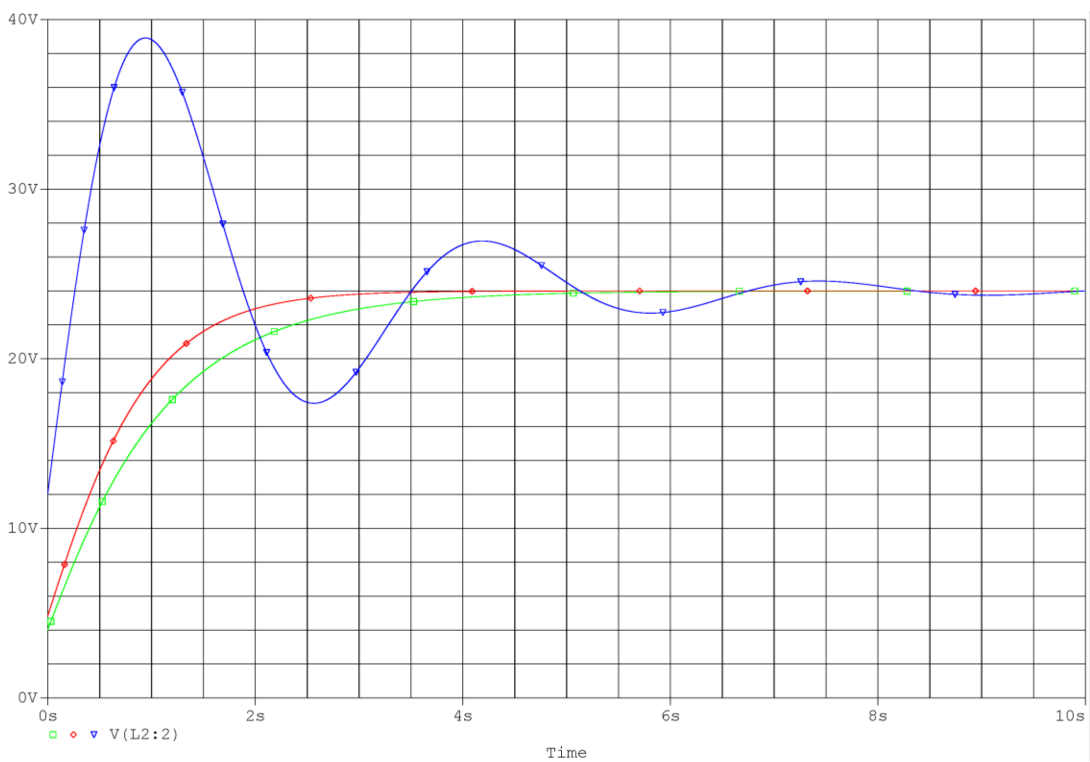


Graph 3: Plot of vc(t) when R = 750, 1250, and 1500 for 0<= t<=13ms

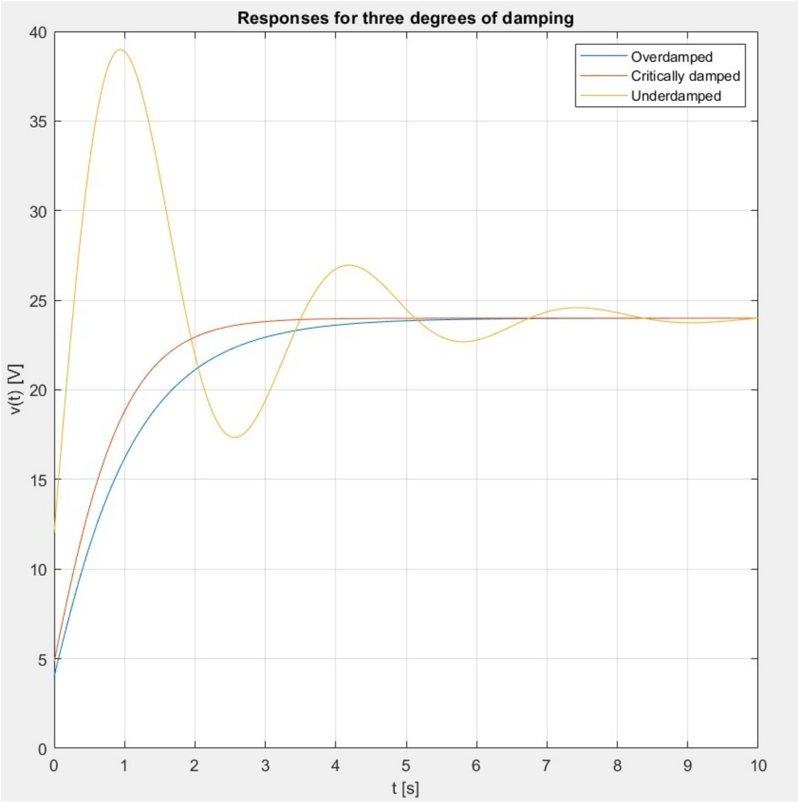
Problem 2:



Graph 4: Plot of i(t) when R = 5, 4, and 1 for 0<= t<=10s



Graph 5: Plot of v(t) when R = 5, 4, and 1 for 0<= t<=10s



Graph 6: Plot of v(t) when R = 5, 4, and 1 for 0<= t<=10s using MATLAB Code

Analysis:

In problem one, the response of the circuit periodically increases to steady-state and then after a few milliseconds, begins decreases to 0V and then the process continues. This is due to our voltage source being a periodic pulse wave. The periods of rising and steady-state coincide with the time where the voltage source is at 5V and the periods of fall are when the source is at 0V. During that time, the storage elements discharge and the resistor dissipates the energy. We also can see for each of the resistor cases, the response is different for each case. When R = 750 Ohms, we can see that the response peaks above the steady-state value and can then identify the response as underdamped. With this information, we can determine that the characteristic equation of the differential equation used to find v(t) has complex roots. When R = 1250 Ohms and when R = 1500 Ohms, we can see that the two responses have a general shape of an exponential while one response increases much greater than the other. The response that increases faster, the response when R = 1250 Ohms can be identified as being critically damped since the et term is multiplied by a term involving t which would result in it increasing far greater than that of an et given enough time. This allows us to conclude that the characteristic equation of the differential equation used to find v(t) has a repeated root. Similarly, the overdamped response can be identified for increasing as a standard exponential rate, this tells us that the characteristic equation has two real solutions.

In problem two, we see that both the current and voltage responses have similar shapes, for the corresponding resistance values, showing that both the voltage and current in second-order circuit take the same general form, but will differ in exact size. In these plots, it is much easier to identify the sinusoidal nature of an underdamped response since you can see the response alternate and you can see the sinewave change towards the steady-state value. For both the critically damped and overdamped responses we can see them both increasing and decreasing to steady-state as time increased. The critically damped response is easier to identify in the current response since you can see part of the hump that is common in critically damped responses that are decreasing. The responses obtained from the MATLAB code are extremely similar, most likely the same depending on the precision of both MATLAB and PSPICE, but from the glancing, at it, they appear to be the same. The plot also shows the same general shape for the responses identified as, underdamped, critically damped, and overdamped.

Conclusion:

Overall the goals of the computer assignment have been met by being able to create circuits in PSPICE using both DC sources and periodic sources along with being able to use PSPICE to plot the responses for various components of the circuit. For both circuits, they were second-order circuits and by using a parametric sweep, the effects that the resistance has on the response were apparent since you could see the responses in the form of underdamped, overdamped, and critically damped if the resistance is at, under, or over a resistance. In circuit one, you can see the effect a periodic signal has on a circuit, and since the circuit used storage elements you can see the components charging and discharging. While in circuit two you could see that both the voltage and current have the same general form but may be increasing or decreasing depending on what is occurring in the circuit. The computer assignment showed students ideas that we have covered in the lecture, but in a manner that is the closest we can get to using equipment in the lab.

Appendix:

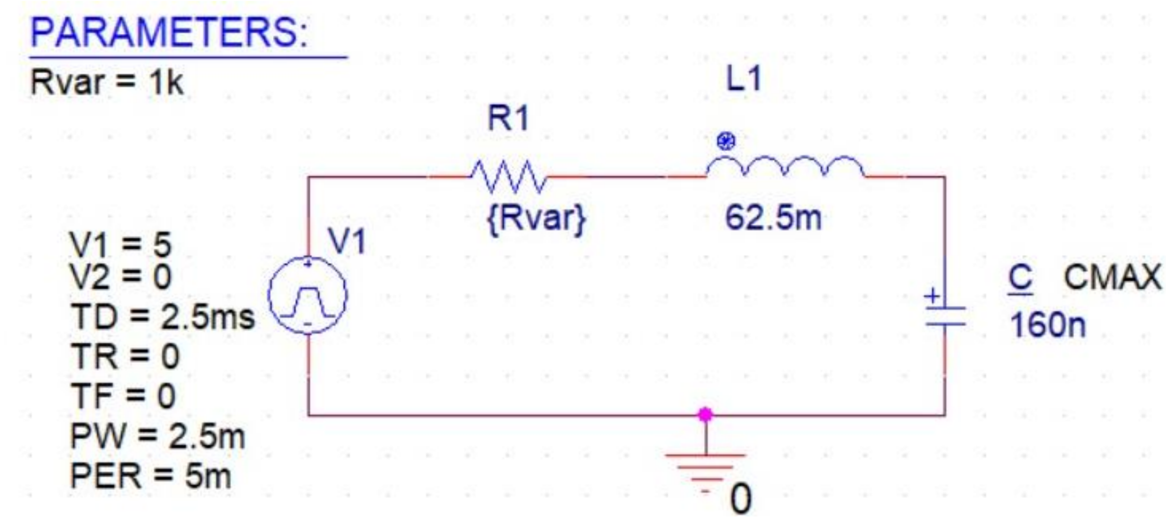


Figure 1: Circuit For Problem 1

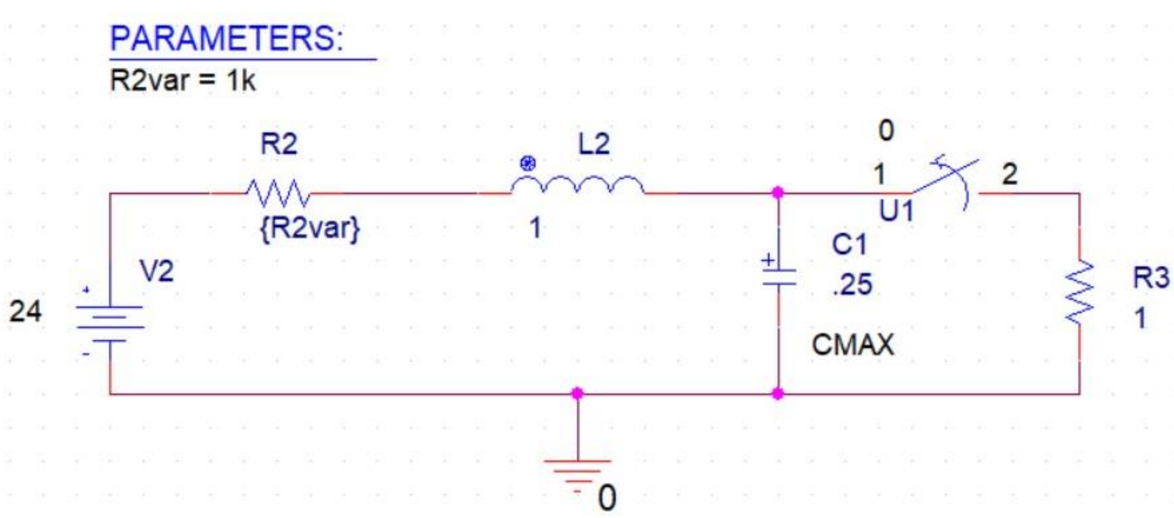


Figure 2: Circuit For Problem 2

MATLAB Code Run From Lecture 4.

```
%Adrian Gonzalez
%11/10/2017
%ECE 2101 - Lecture 4, Example 1.
clc; clear; close all;
syms v(t) t
R = [5 4 1]; %Three cases
legends = {1,length(R)};
L = 1;
C = 0.25;
Vs = 24;
R1 = 1; %1 ohm resistor for t < 0
time = linspace(0,10,1000); %Time vector to plot response
%initial conditions:
for i=1:length(R)
    alpha = R(i)/(2*L);
    omega0 = 1/sqrt(L*C);
    I0 = Vs/(R(i) + 1); %Update R for each case
    V0 = I0*R1;
    dV0dt = I0/C;

    Deq = diff(v,t,2) + (R(i)/L)*diff(v,t) + v/(L*C) == Vs/(L*C); %2nd order
diff. eqn.
    dvdt = diff(v,t);
    cond = [v(0) == V0, dvdt(0) == dV0dt]; %Initial conditions
    V = dsolve(Deq, cond);
    if (alpha > omega0)
        fprintf('CASE %d: R = %.3f ohms (overdamped response)\n\n', i, R(i));
        fprintf('v(t) =\n\n');
        pretty(vpa(V,5));
        plot(time, double(subs(V,t,time))); %Plot the response
        legends{i} = 'Overdamped';
        hold on;
    elseif (alpha == omega0)
        fprintf('CASE %d: R = %.3f ohms (critically damped response)\n\n', i,
R(i));
        fprintf('v(t) =\n\n');
        pretty(vpa(V,5));
        plot(time, double(subs(V,t,time))); %Plot the response
        legends{i} = 'Critically damped';
        hold on;
    elseif (alpha < omega0)
        fprintf('CASE %d: R = %.3f ohms (underdamped response)\n\n', i,
R(i));
        fprintf('v(t) =\n\n');
        pretty(vpa(V,5));
        plot(time, double(subs(V,t,time))); %Plot the response
        legends{i} = 'Underdamped';
        hold on;
    end
end
title('Responses for three degrees of damping');
xlabel('t [s]'); ylabel('v(t) [V]');
grid on; legend(legends);
```