Electrical Engineering Department

Prelab3

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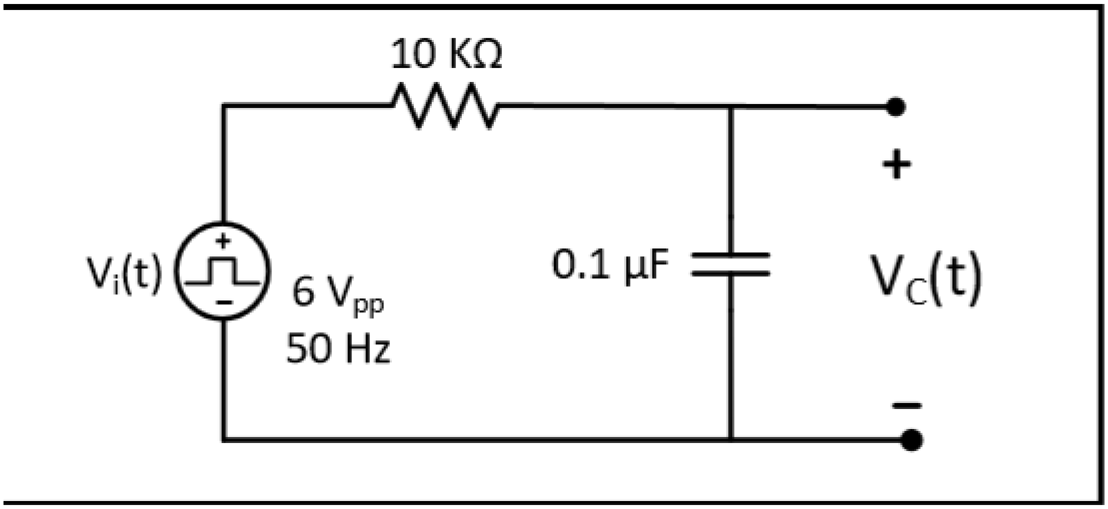
Date:29/9/2018

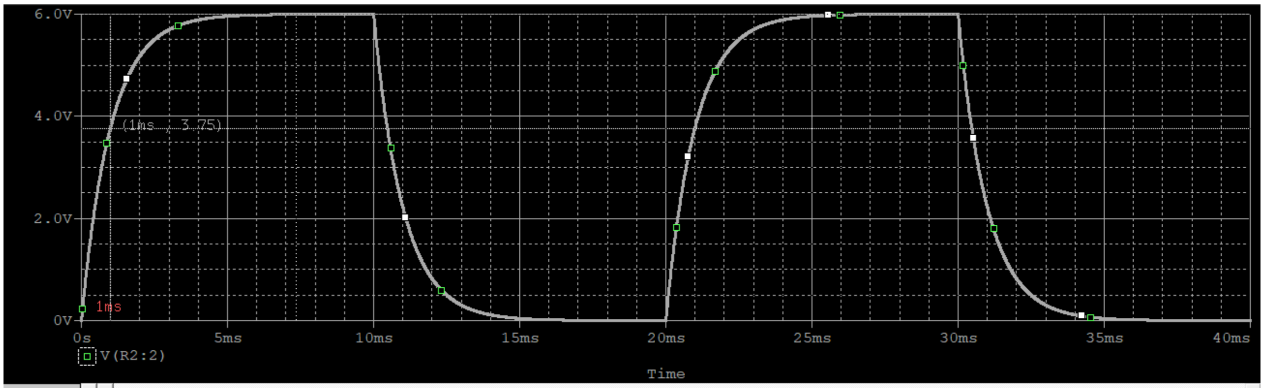
Part A: Step response of First-order RC circuit

For the circuit of Figure 5.8 :



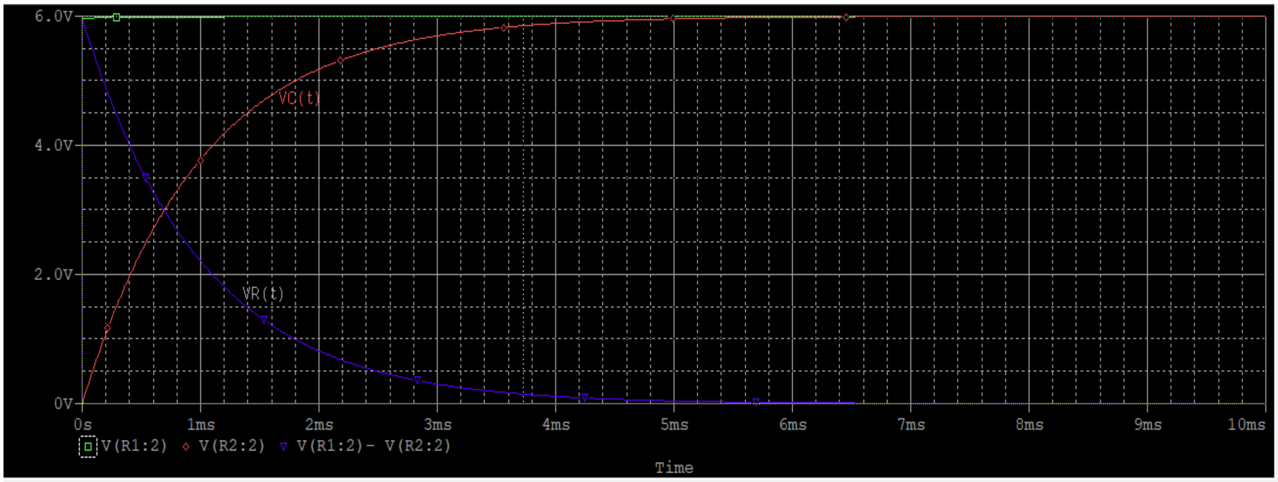
1. Calculate VC (t) using the general solution formula, show calculation of time constant (τ).
   VC(t) = V(inf)+((V(0)-V(inf))e^(-t/toe)
   V(0) = 0
   V(inf) = 6V
   Toe = (Rth*C) = (10K*0.1*10^-6) = 1ms
   VC(t) = 6(1-e^(-1000t))

2. Use PSPICE to do transient analysis of the circuit. Show VC(t) and use cursors to measure time constant (**τ**).



   V(toe) = 0.63*Vmax = 3.75
   Toe = 1ms

3. For the same circuit show VR(t) using a differential voltage marker, and use cursors to measure time constant (**τ**).



Part B: Step response of First-order RL circuit For the circuit of Figure 5.10:

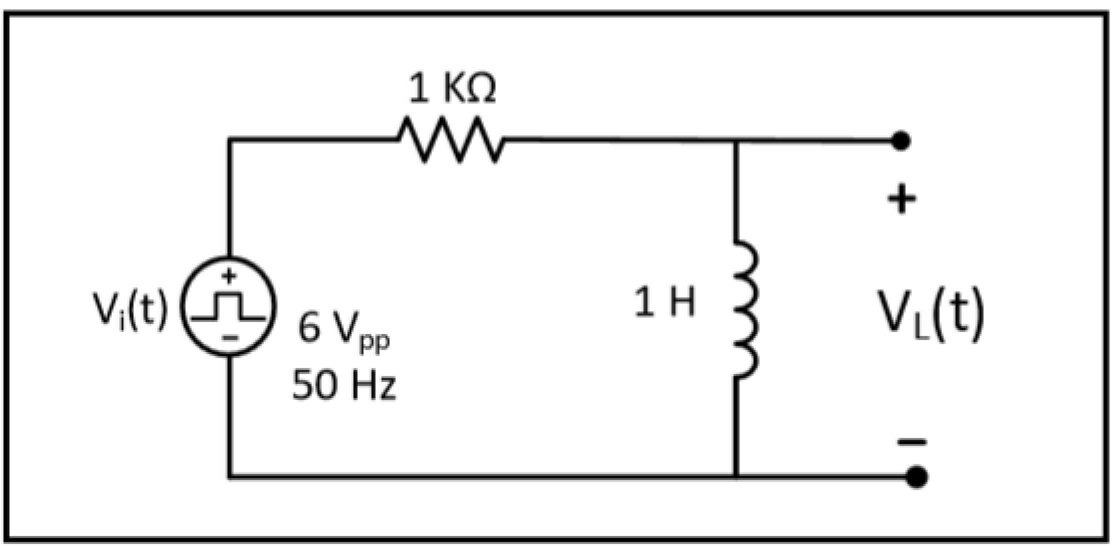


Figure 5.10

VL(t) = V(inf)+((V(0)-V(inf))e^(-t/toe)

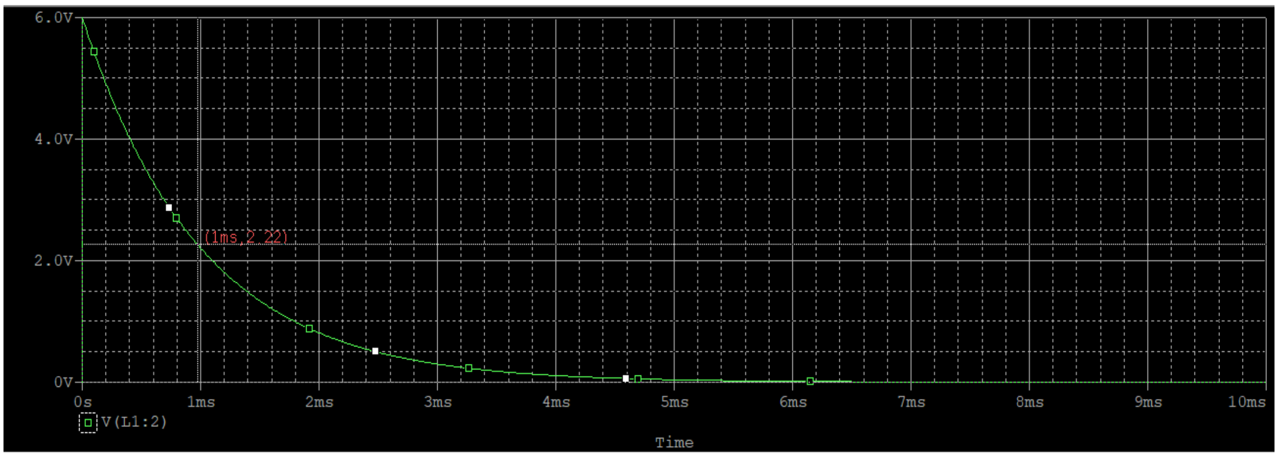
V(inf) = 0

V(0) =Vin max = 6V

Toe = L/R = 1ms

VL(t) = 6*e^(-1000*t)

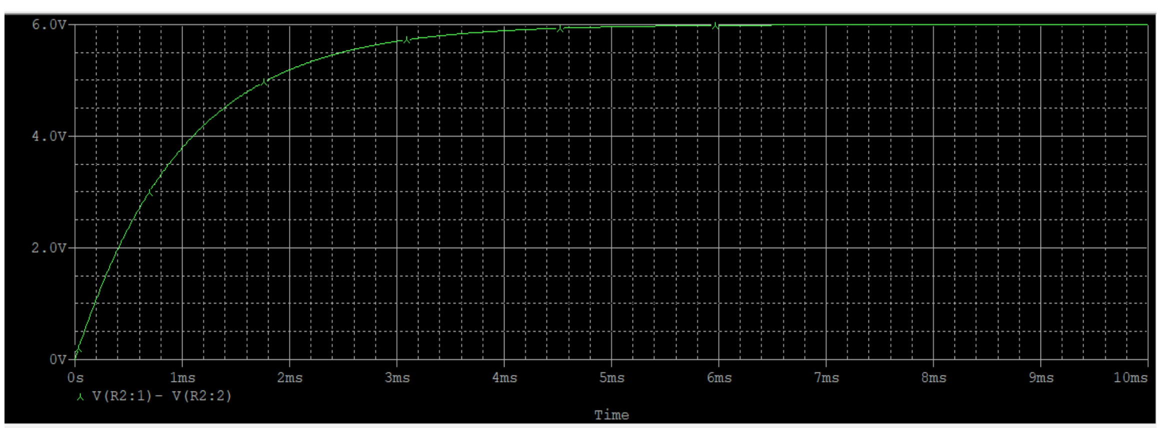
2. Use PSPICE to do transient analysis of the circuit. Show VL(t) and use cursors to measure time constant (τ).



V(toe) = 0.37*Vmax = 2.22

3.For the same circuit show VR(t) using a differential voltage marker, and use cursors to measure time constant (τ).

4.



Part C: Step response of second-order Series RLC circuit

For the circuit of Figure 5.12:

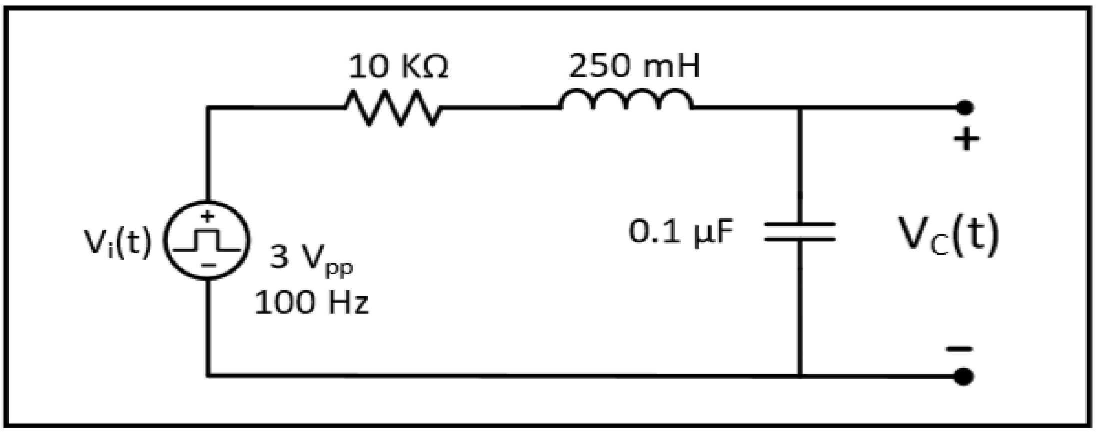


Figure 5.12

α = R/(2*L) = 20000

W0 = 1/(LC)^0.5 = 6324

α ^2>w0^2

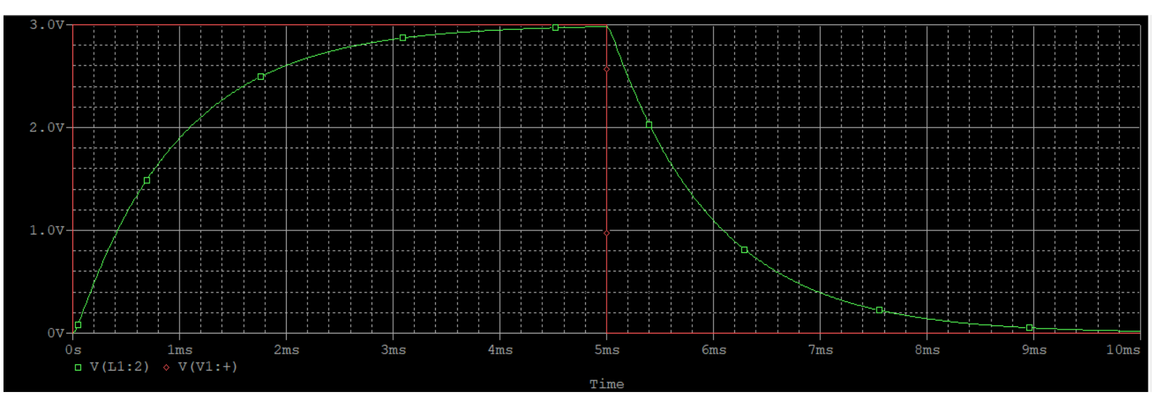
The system is over damped

S1,2 = -(α)+-(α ^2-W0^2)^.5

S1 = -1026

S2 = -38974

Vc(t) =3+Ae^-1026t + Be^-38974t



2. Calculate the critical resistance RC that will result in equal roots (S1 = S2 = -?) and write an expression for VC(t). Use PSPICE to do transient analysis of the circuit and show VC(t).

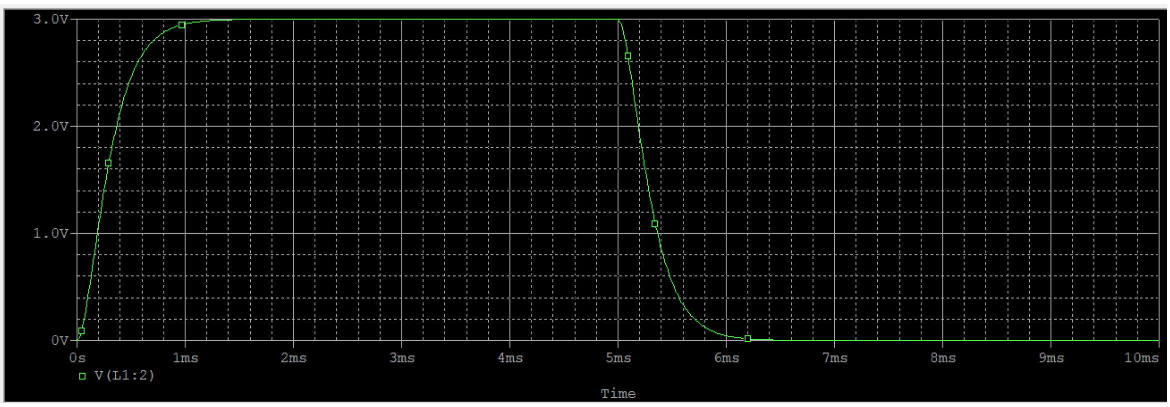
W0^2 = **α** ^2

1/(LC) = Rc^2/4L^2

R^2 = 4*L/C = 3.2 Kohm

α = Rc/2L = 6400

Vc(t) = Ae^(-6400t)



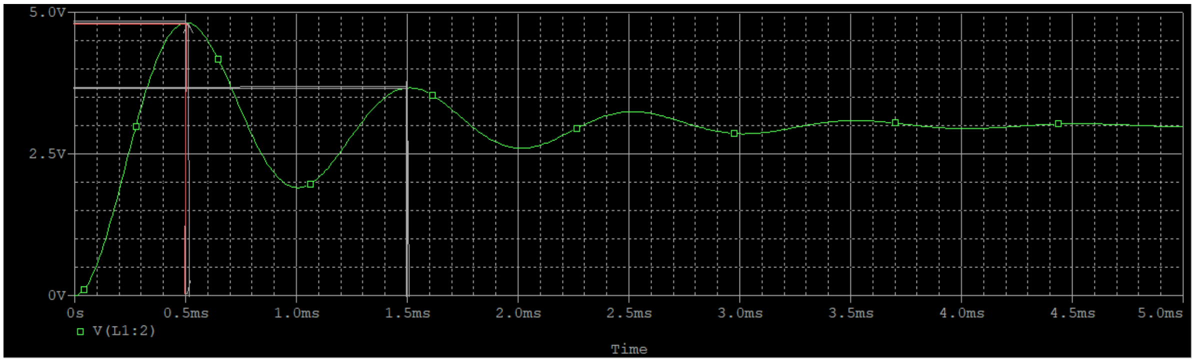
3. For R = 500 Ω, calculate the roots of the characteristic equation, showing the value of **α and ωd** and write an expression for VC(t). Use PSPICE to do transient analysis of the circuit, show VC(t), and measure **α and ωd** using cursors as shown in figure 5.7.

α =R/2L = 1000   W0 = 6400

W0 > **α**   the system is under damping

Wd=(W0^2- **α**^)^.5 = 6320

Vc(t) =3+ e^(-1000t)(Acos6320t + B sin 6320t)



$\tau = tb - ta / \ln(Va - Vo(\infty) / Vb - Vo(\infty))$

Tb = 1.5ms   ta = 0.5 ms

Va = 4.8   Vb = 3,65   v(inf) = 3V

τ = 0.97 ms

α = 1/ τ = 1030

Wd = $2\pi / tb - ta = 6300$

Part D: Step response of second-order parallel RLC circuit

For the circuit of Figure 5.13:

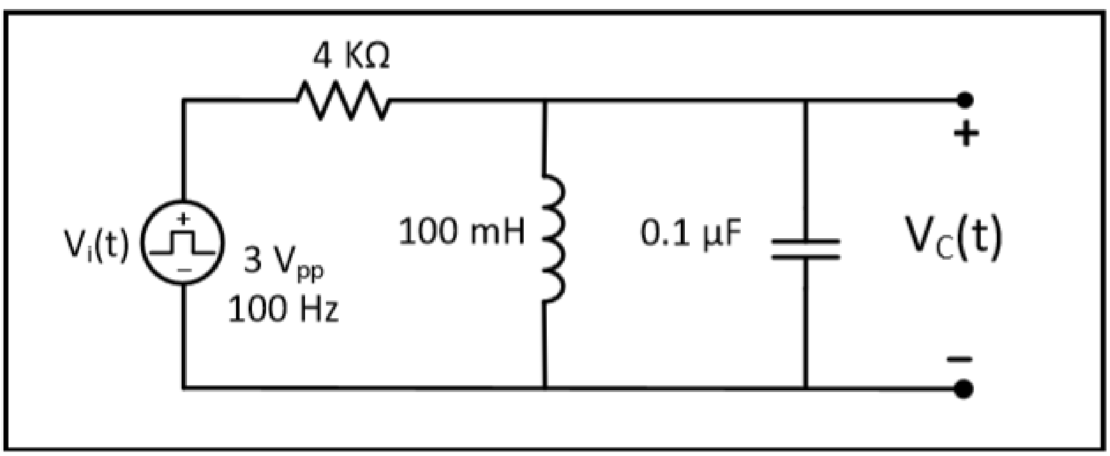


Figure 5.13

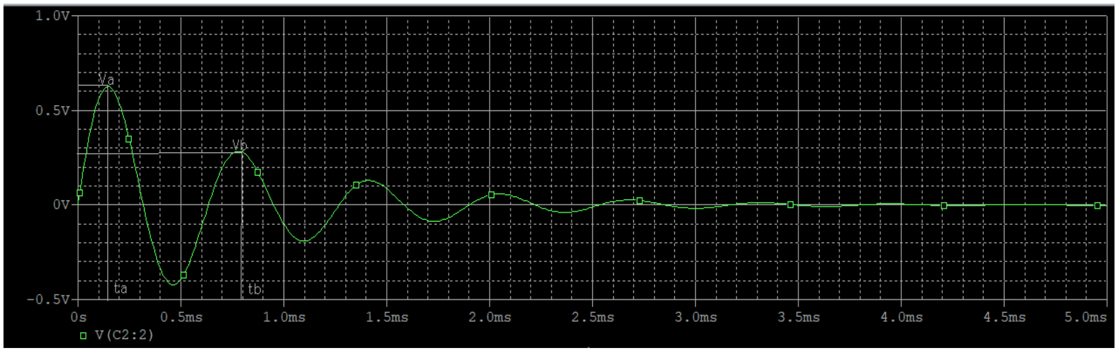
1. For R = 4 kΩ, calculate the roots of the characteristic equation showing the value of **α and ωd**. Write an expression of VC(t). Use PSPICE to do transient analysis of the circuit, show VC(t), and measure **α and ωd** using cursors as shown in figure 5.7.

$\boldsymbol{\alpha}$ = 1/2RC = 1250   W0 = 10000

W0> $\boldsymbol{\alpha}$ the system is under damping

Wd = (W0^2- $\boldsymbol{\alpha}$^2)^0.5 = 9950

Vc(t) = e^(-1250t)*(A cos9950t + B sin9950t)



$\tau = tb - ta /\ ln(\ Va - Vo(\infty) /\ Vb - Vo(\infty))$

Tb = 0.8ms   ta = 0.15ms   Va =0.6 V   Vb = 0.3V

τ = 0.93 ms $\boldsymbol{\alpha}$ = 1066

Wd = $2\pi /\ tb - ta$ =9700

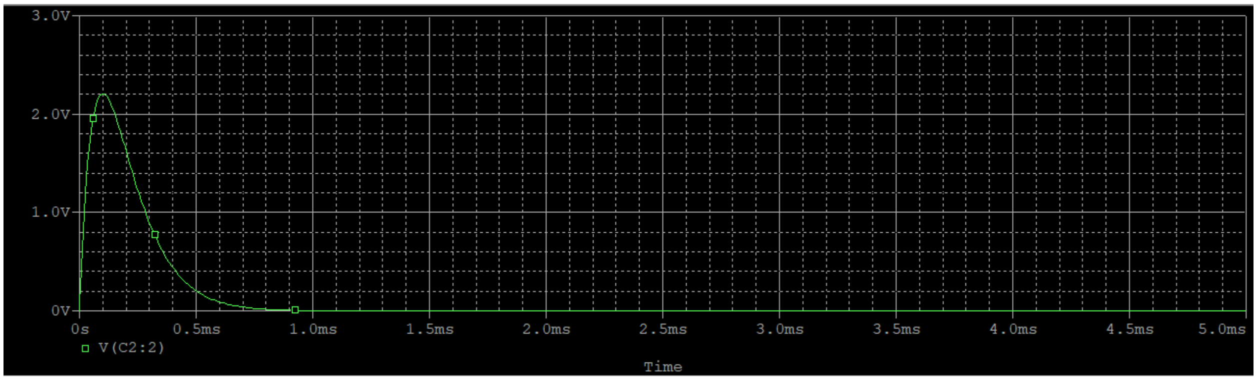
2. Calculate the critical resistance RC that will result in equal roots (S1 = S2 = - □) and write an expression for VC(t). Use PSPICE to do transient analysis of the circuit and show VC(t).

W0^2 = $\boldsymbol{\alpha}$^2

Rc = (L/4C)^.5 = 500 ohm

$\boldsymbol{\alpha}$ = 10000

Vc(t) = Ae^(-10000t)



For R = 150 Ω, calculate the roots of the characteristic equation and write an expression for VC(t). Use PSPICE to do transient analysis of the circuit, and show VC(t).

$\alpha = 1/2RC = 33333$ $W0 = 10000$

$\alpha >$W0   the system is over damped

S1,2 = - α+_(α^2-W0^2)^0.5

S1 = -1535   S2 = -65130

Vc(t) = A e^(-1535t) + B e^(-65130t)