Electrical Engineering Department

Prelab3

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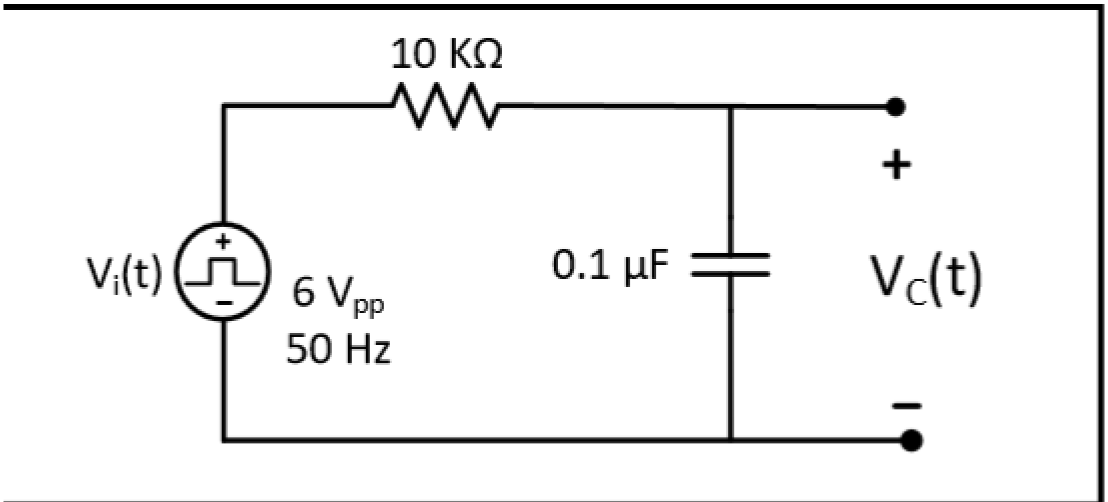
Date:29/9/2018

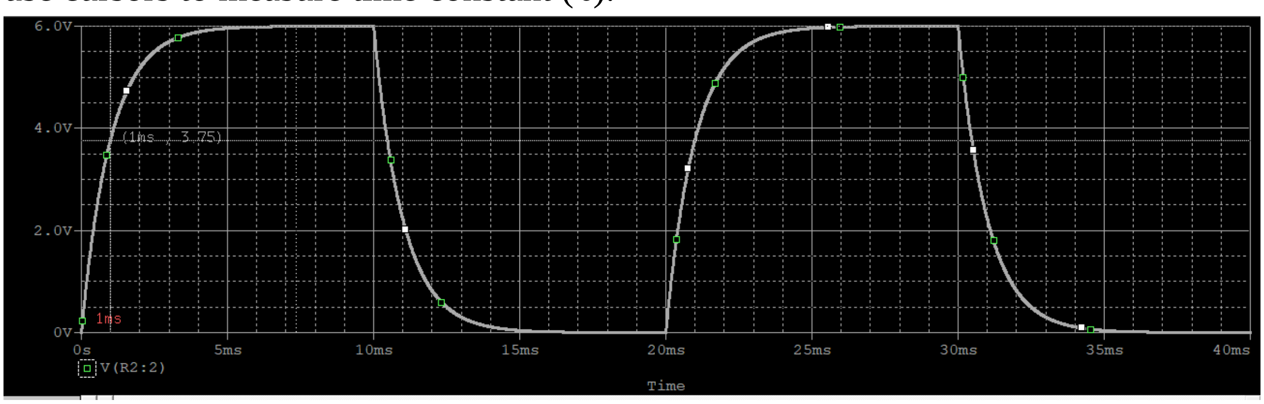
Part A: Step response of First-order RC circuit

For the circuit of Figure 5.8 :



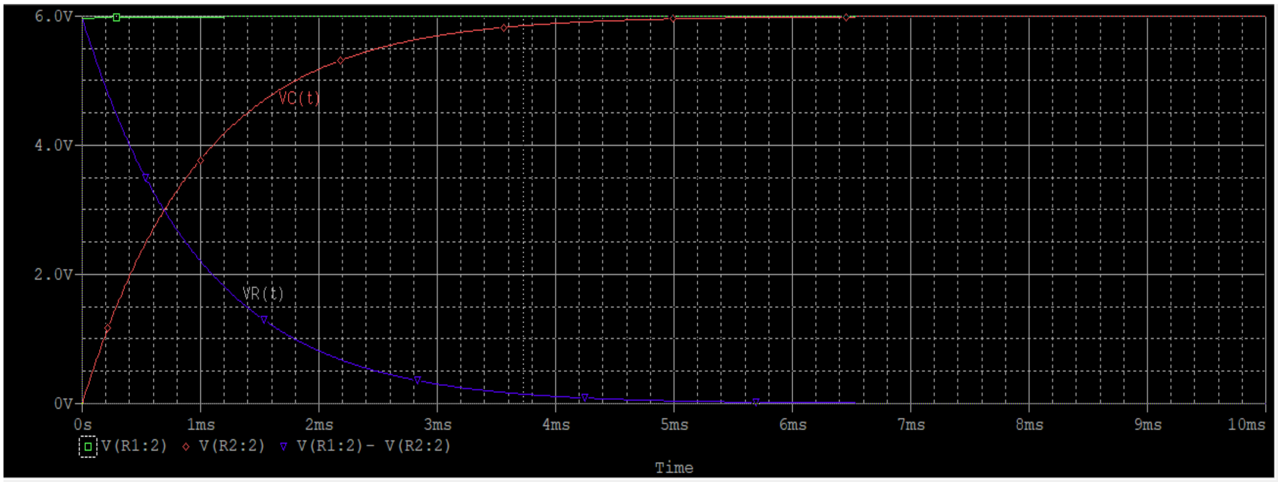
1. Calculate VC (t) using the general solution formula, show calculation of time constant (τ).
   VC(t) = V(inf)+((V(0)-V(inf))e^(-t/toe)
   V(0) = 0
   V(inf) = 6V
   Toe = (Rth*C) = (10K*0.1*10^-6) = 1ms
   VC(t) = 6(1-e^(-1000t))

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:

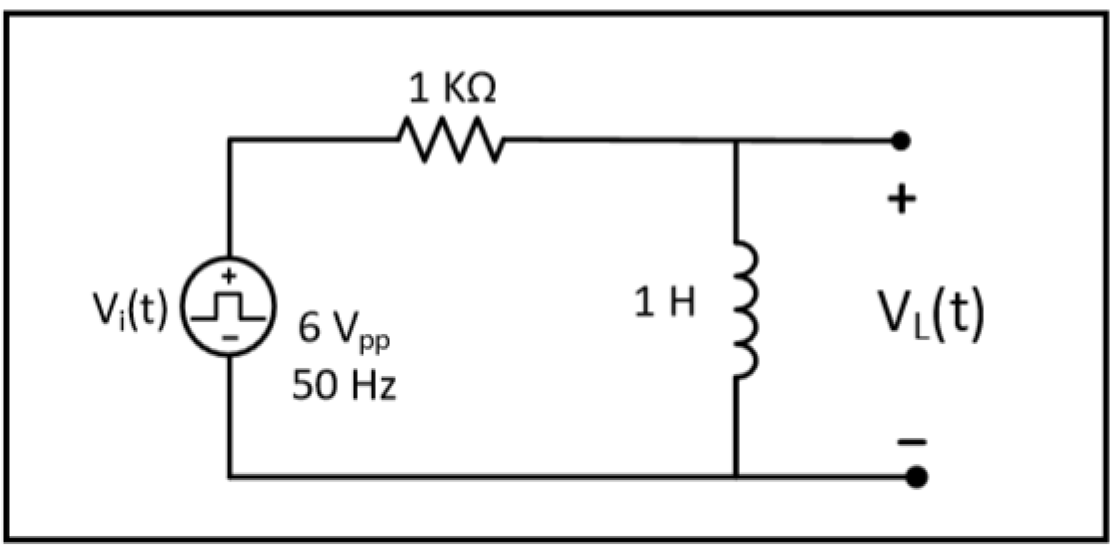


Figure 5.10

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

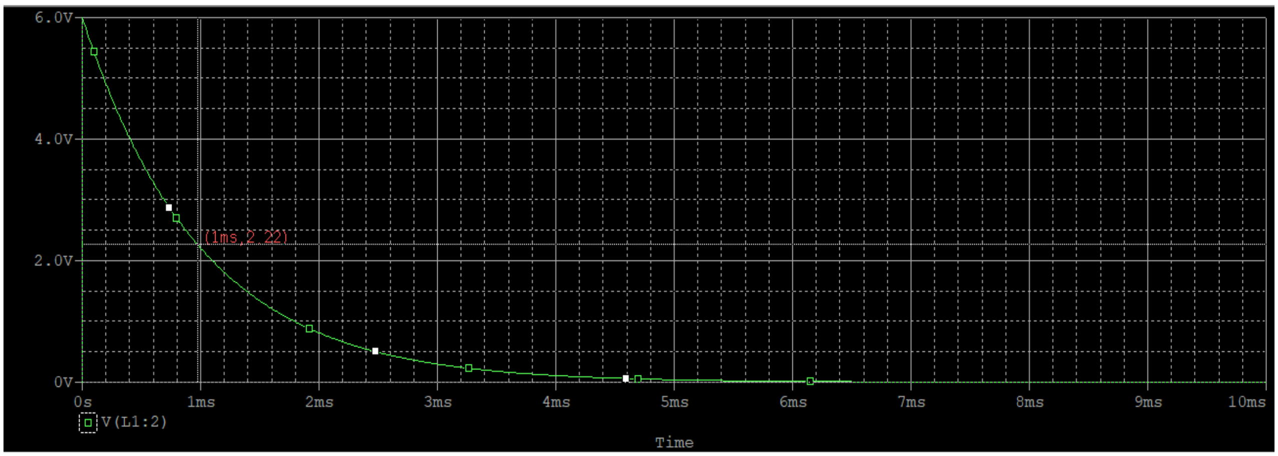
V(inf) = 0

V(0) =Vin max = 6V

Toe = L/R = 1ms

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

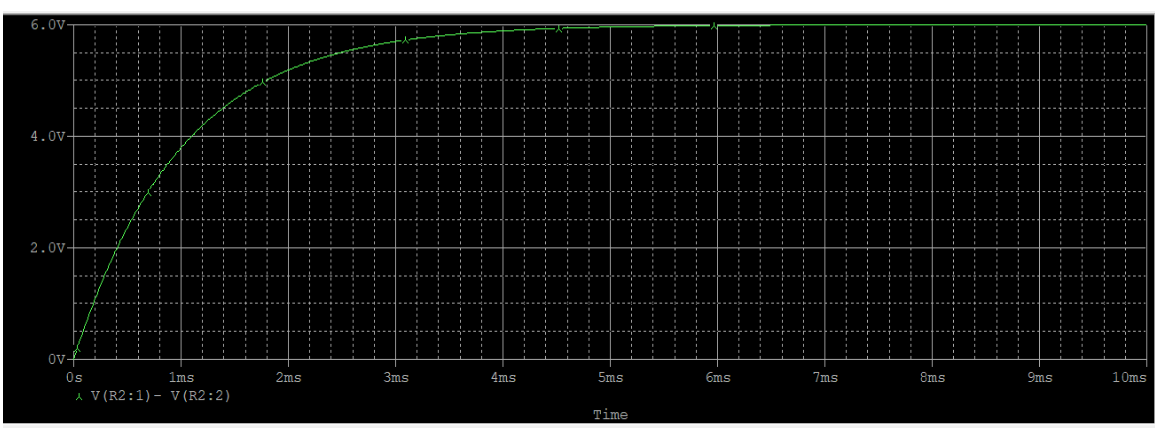
2. Use PSPICE to do transient analysis of the circuit. Show VL(t) and use cursors to measure time constant (τ).



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:

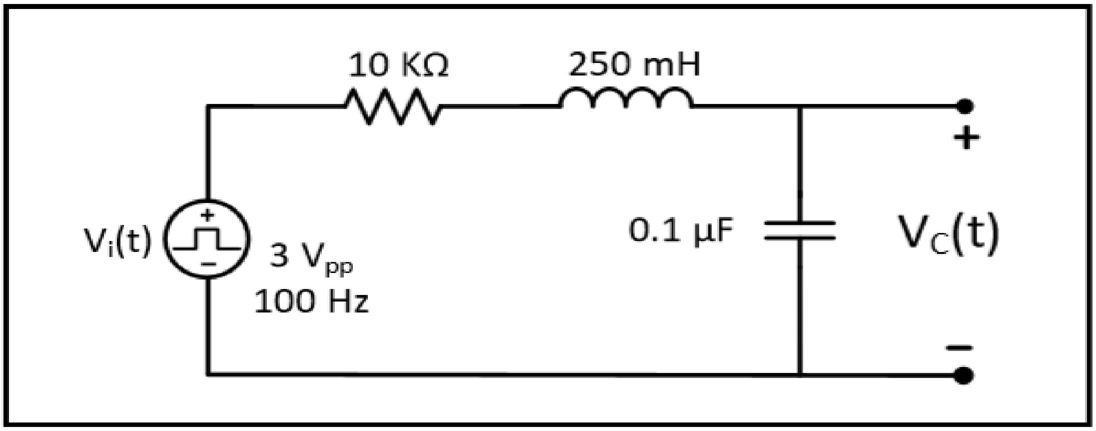


Figure 5.12

$\alpha = R/(2*L) = 20000$

$W0 = 1/(LC)^{0.5} = 6324$

$\alpha^2 > w0^2$

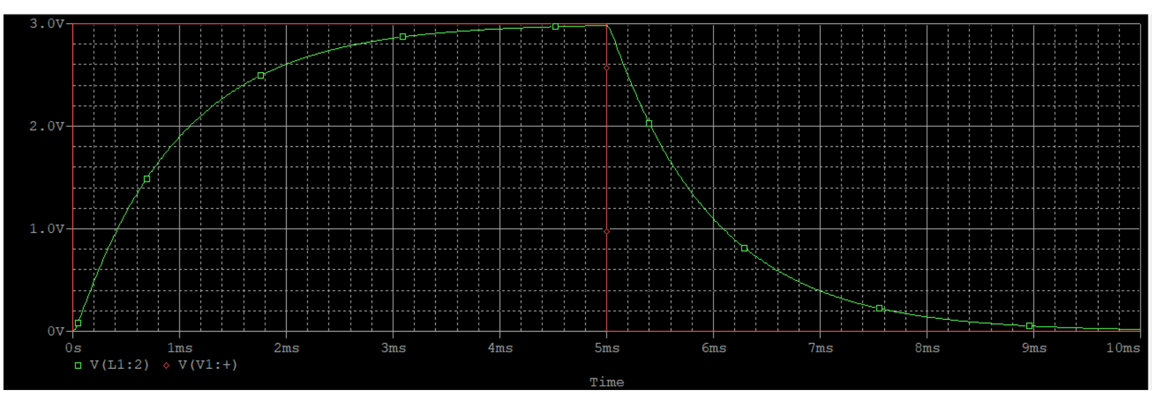
The system is over damped

$S1,2 = -(\alpha) \pm (\alpha^2 - W0^2)^{.5}$

$S1 = -1026$

$S2 = -38974$

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



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).

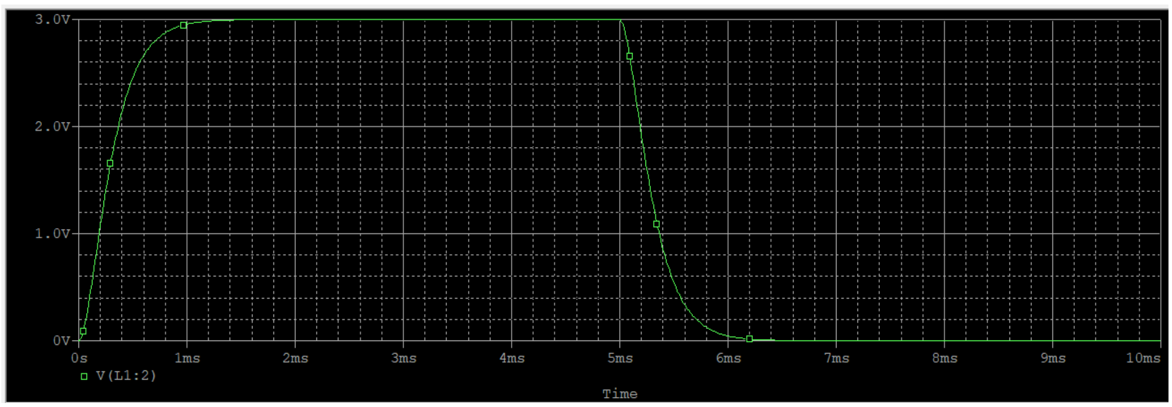
$W0^2 = \boldsymbol{\alpha}^2$

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

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

$\boldsymbol{\alpha} = Rc/2L = 6400$

$Vc(t) = Ae^{(-6400t)}$



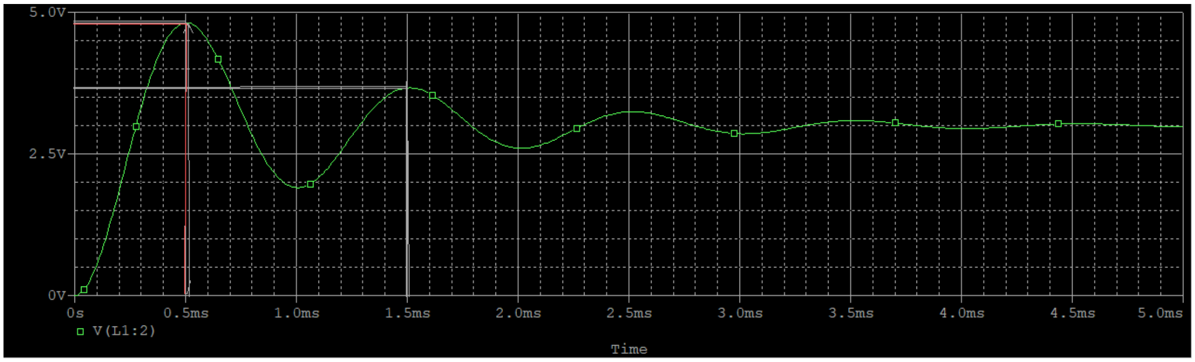
3. For R = 500 Ω, calculate the roots of the characteristic equation, showing the value of $\boldsymbol{\alpha}$ **and** $\boldsymbol{\omega d}$ and write an expression for VC(t). Use PSPICE to do transient analysis of the circuit, show VC(t), and measure $\boldsymbol{\alpha}$ **and** $\boldsymbol{\omega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

$\boldsymbol{\alpha} = R/2L = 1000 \qquad W0 = 6400$

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

$Wd = (W0^2 - \boldsymbol{\alpha}^{\wedge})^{.5} = 6320$

$Vc(t) = 3 + e^{(-1000t)}(A\cos 6320t + B \sin 6320t)$



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

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:

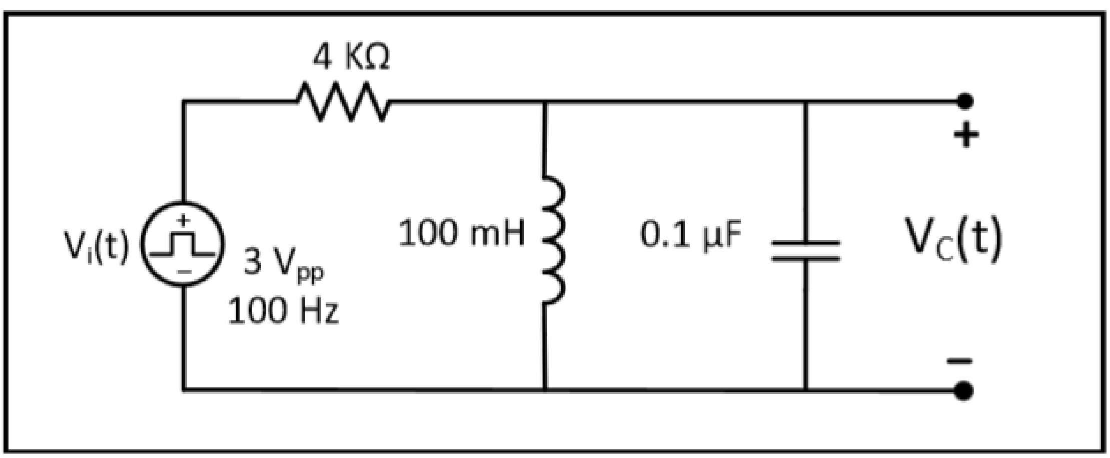


Figure 5.13

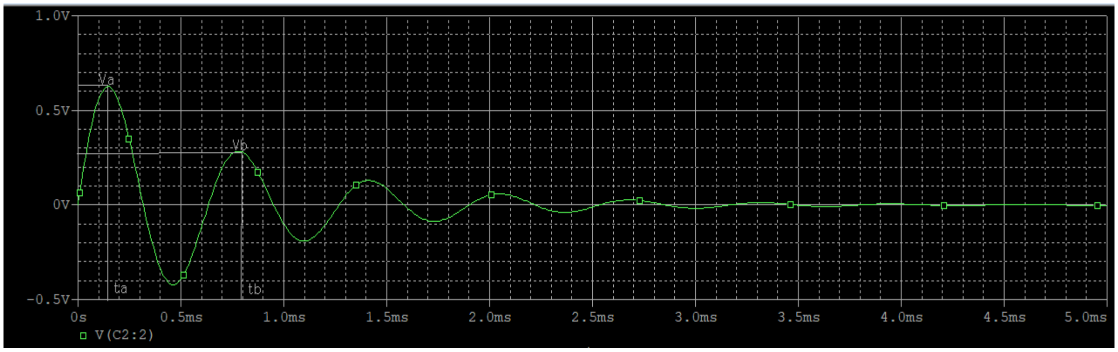
1. For R = 4 kΩ, calculate the roots of the characteristic equation showing the value of **α and ωd**. Write an expression of VC(t). Use PSPICE to do transient analysis of the circuit, show VC(t), and measure **α and ωd** using cursors as shown in figure 5.7.

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

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

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

$Vc(t) = e^{(-1250t)} * (A \cos 9950t + B \sin 9950t)$



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

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

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

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

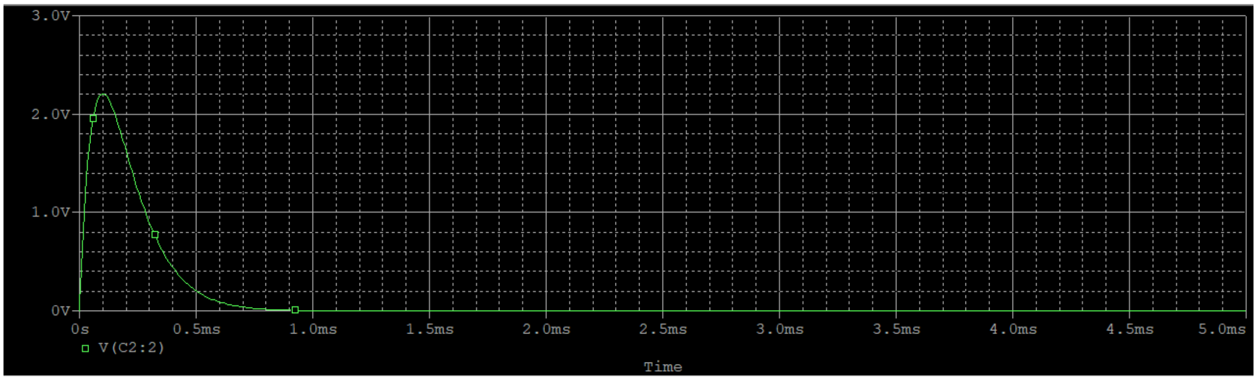
2. Calculate the critical resistance RC that will result in equal roots (S1 = S2 = - ⍰) and write an expression for VC(t). Use PSPICE to do transient analysis of the circuit and show VC(t).

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

$Rc = (L/4C)^{.5} = 500$ 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).

$\boldsymbol{\alpha} = 1/2RC = 33333 \qquad W0 = 10000$

$\boldsymbol{\alpha} > W0 \qquad$ 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)