Electrical Engineering Department

Prelab3

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Instructor: Dr. Muhammad jubran section:1

Date:29/9/2018

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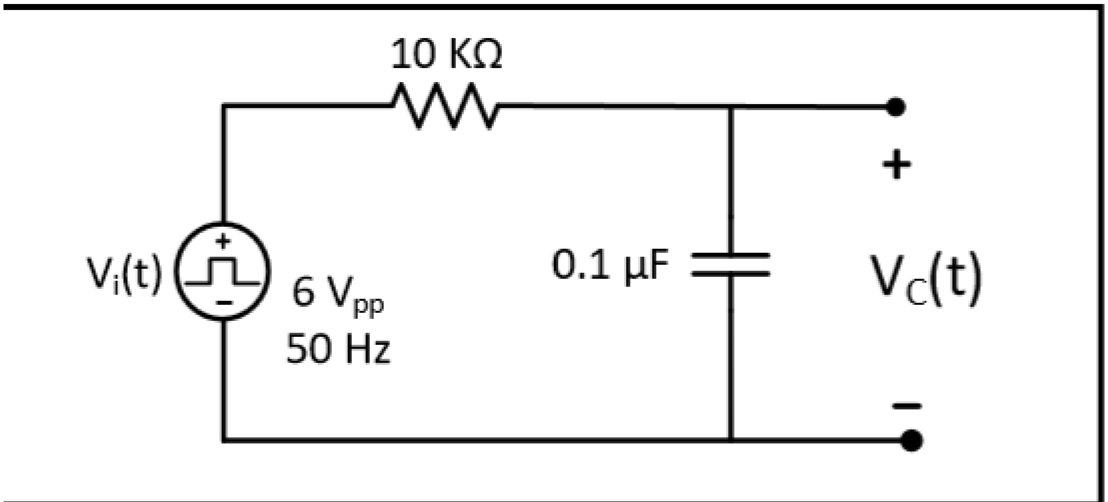
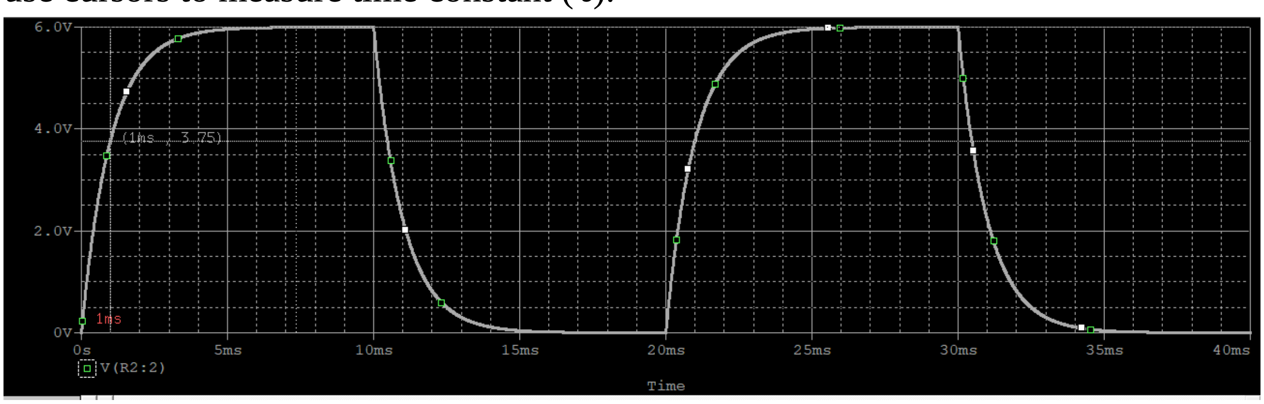
Part A: Step response of First-order RC circuit

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

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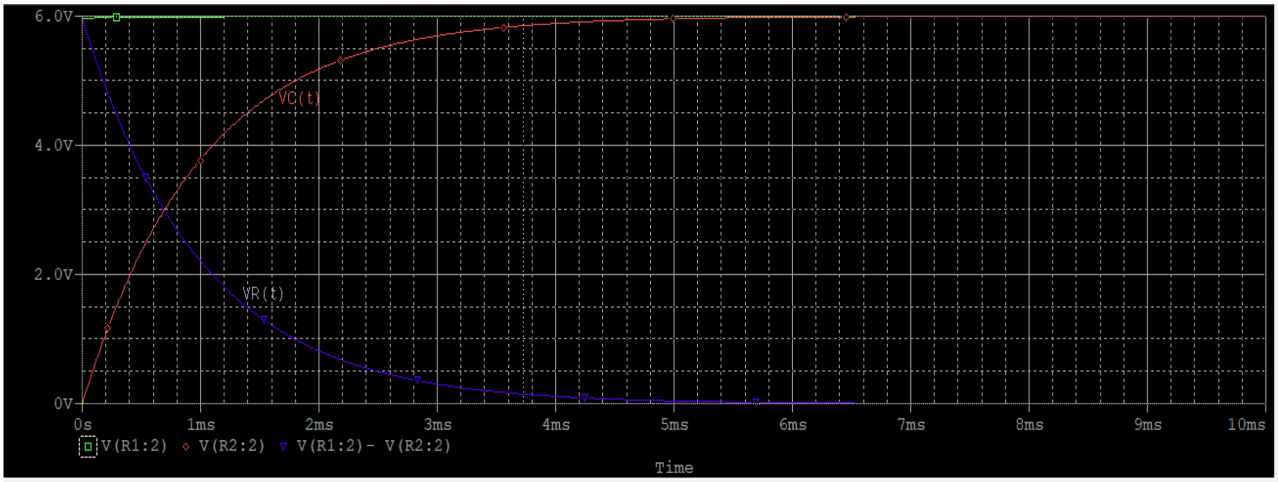
3. For the same circuit show VR(t) using a differential voltage marker, and use cursors to measure time constant (**τ**).



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

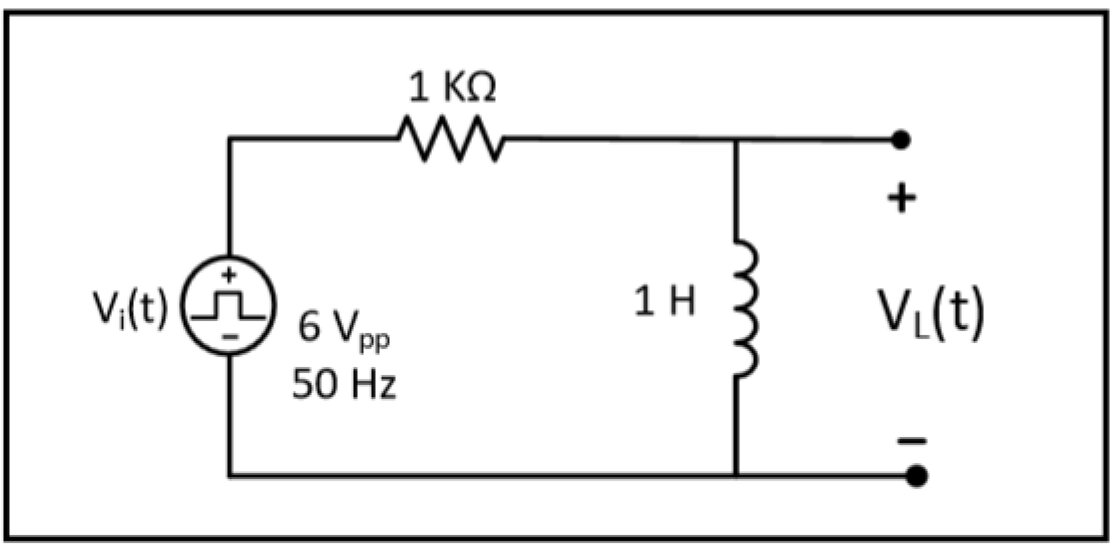


Figure 5.10

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

V(inf) = 0

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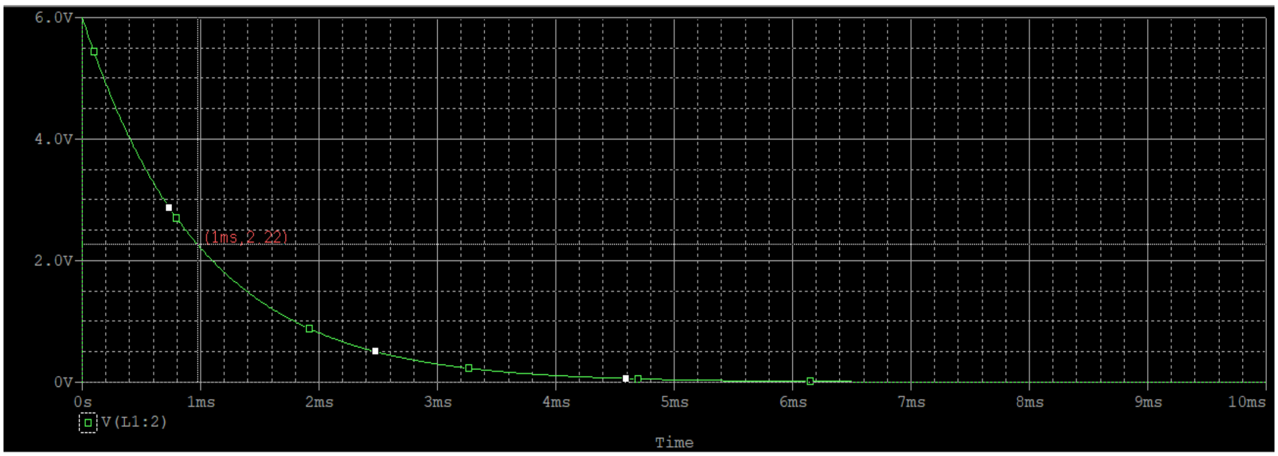
V(0) =Vin max = 6V

Toe = L/R = 1ms

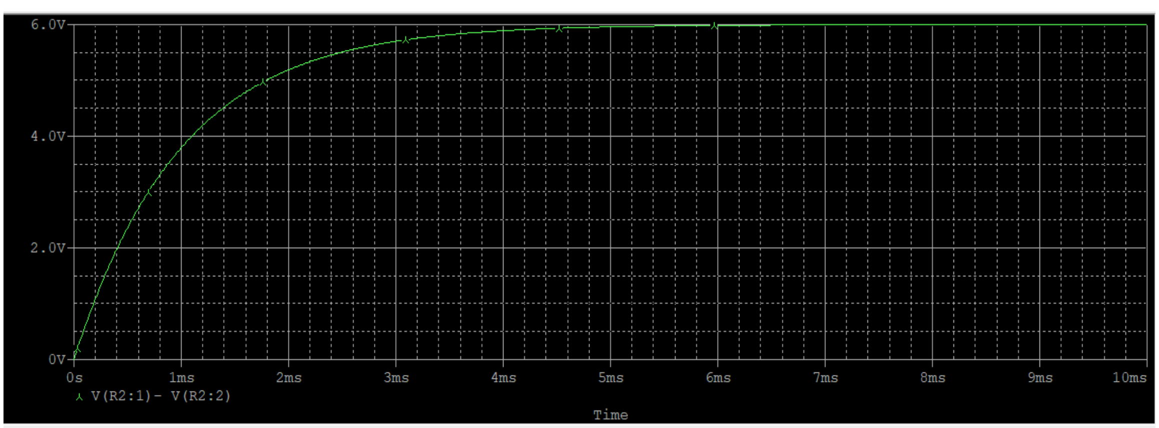
VL(t) = 6*e^(-1000*t)

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. 

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

For the circuit of Figure 5.12:

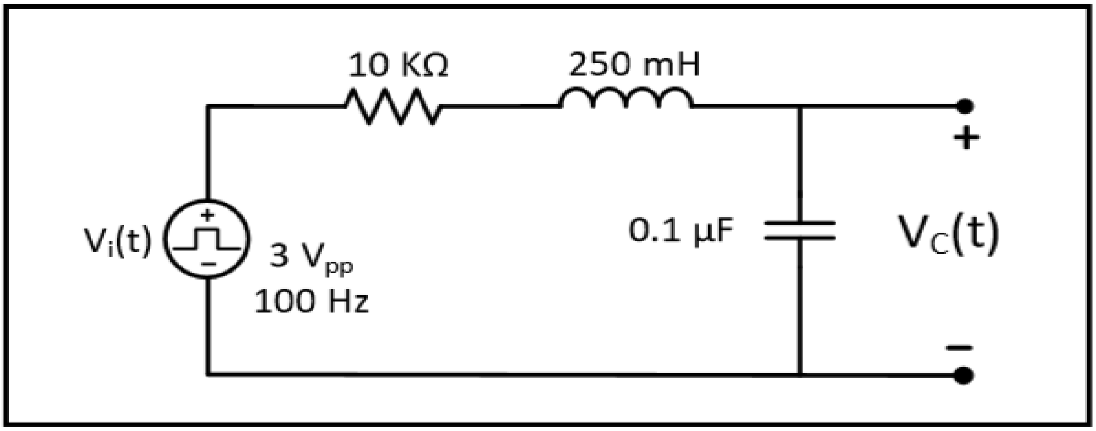


Figure 5.12

α = R/(2*L) = 20000

W0 = 1/(LC)^0.5 = 6324

α ^2>w0^2

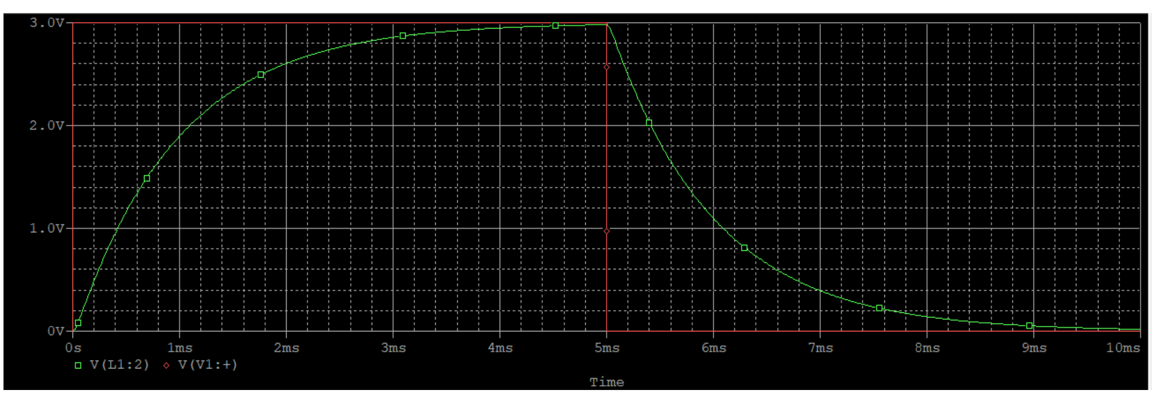
The system is over damped

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).

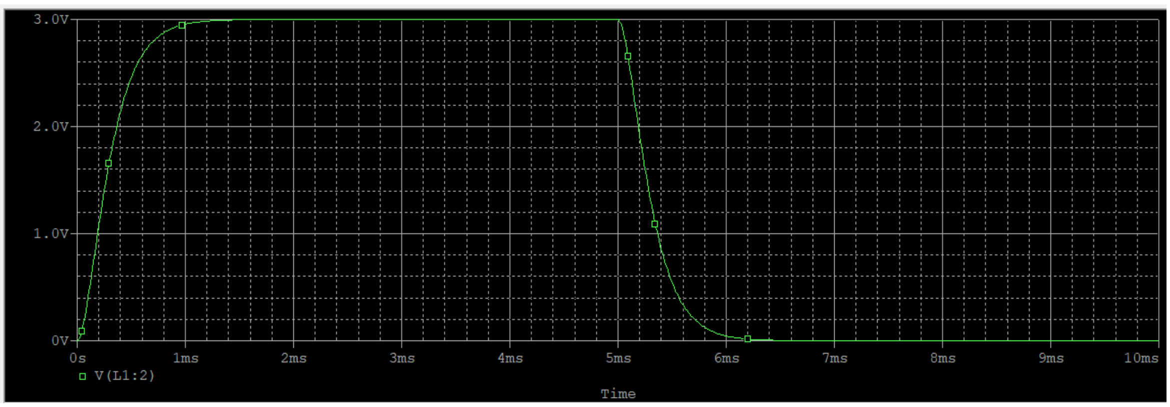
$W0^2 = \alpha^2$

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

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

$\alpha = Rc/2L = 6400$

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



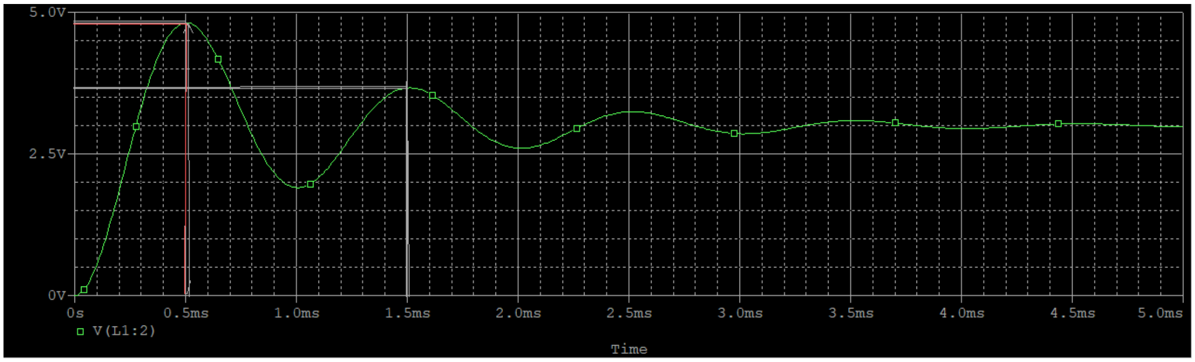
3. For R = 500 Ω, calculate the roots of the characteristic equation, showing the value of **α and ωd** and write an expression for VC(t). Use PSPICE to do transient analysis of the circuit, show VC(t), and measure **α and ωd** using cursors as shown in figure 5.7.

$\alpha = R/2L = 1000$ $\quad\quad W0 = 6400$

$W0 > \alpha$ the system is under damping

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

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



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

Tb = 1.5ms   ta = 0.5 ms

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

$\tau = 0.97$ ms

$\boldsymbol{\alpha} = 1/\tau = 1030$

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

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

For the circuit of Figure 5.13:

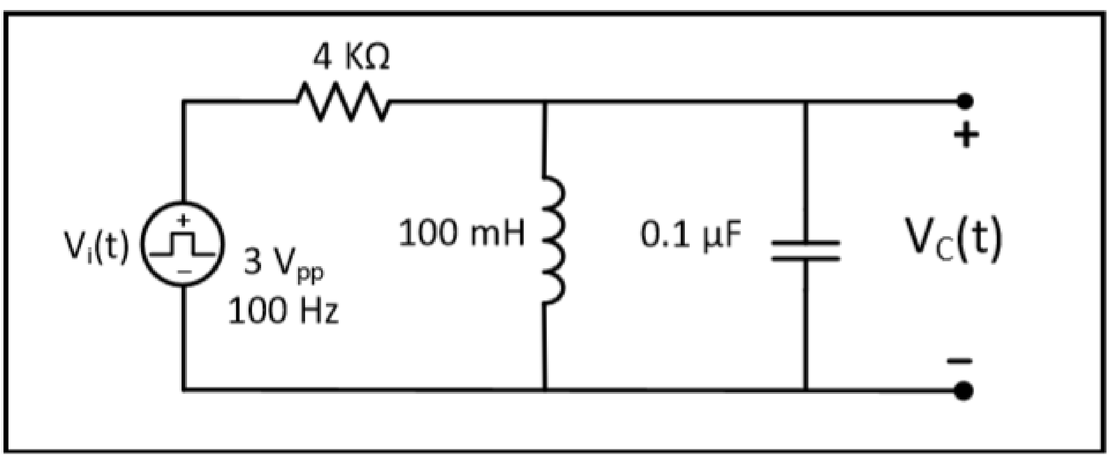


Figure 5.13

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.

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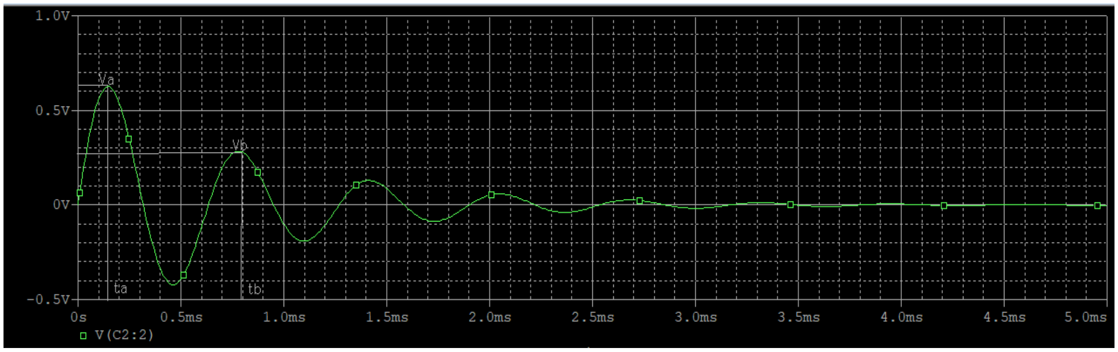
$\boldsymbol{\alpha}$ = 1/2RC = 1250 W0 = 10000

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)

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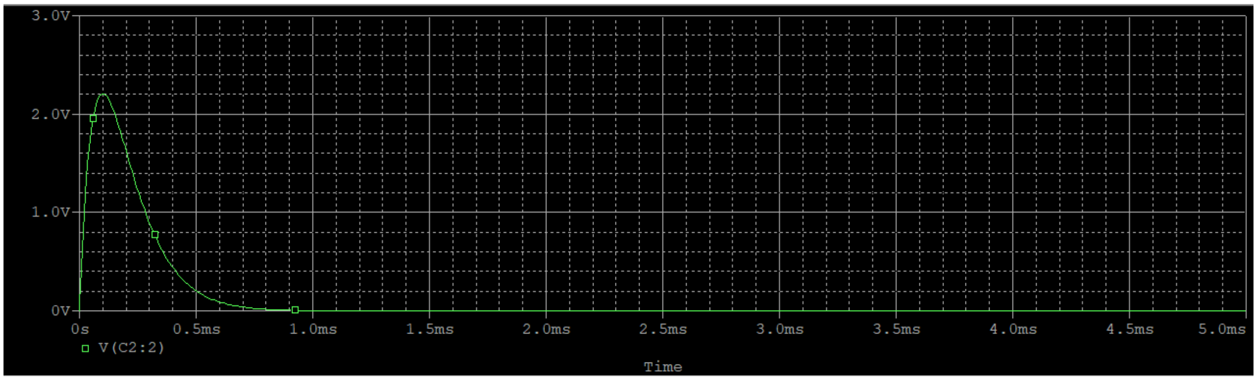

For R = 150 Ω, calculate the roots of the characteristic equation and write an expression for VC(t). Use PSPICE to do transient analysis of the circuit, and show VC(t).

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

$\boldsymbol{\alpha} > W0$ the system is over damped

S1,2 = - $\boldsymbol{\alpha}$+_($\boldsymbol{\alpha}$^2-W0^2)^0.5

S1 = -1535 S2 = -65130

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