Chapter 8, Solution 16.

At $t = 0$, $i(0) = 0$, $v_C(0) = 40x30/50 = 24V$

For $t > 0$, we have a source-free RLC circuit.

$$\alpha = R/(2L) = (40 + 60)/5 = 20 \text{ and } \omega_o = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{10^{-3}x2.5}} = 20$$

$\omega_o = \alpha$ leads to critical damping

$$i(t) = [(A + Bt)e^{-20t}], \; i(0) = 0 = A$$

$$di/dt = \{[Be^{-20t}] + [-20(Bt)e^{-20t}]\},$$

$$\text{but } di(0)/dt = -(1/L)[Ri(0) + v_C(0)] = -(1/2.5)[0 + 24]$$

Hence, $B = -9.6$ or $i(t) =$ **$[-9.6te^{-20t}]$ A**

Chapter 8, Solution 23.

Let $C_o = C + 0.01$. For a parallel RLC circuit,

$$\alpha = 1/(2RC_o), \; \omega_o = 1/\sqrt{LC_o}$$

$\alpha = 1 = 1/(2RC_o)$, we then have $C_o = 1/(2R) = 1/20 = 50$ mF

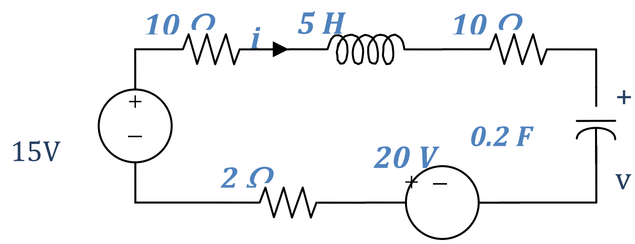
$$\omega_o = 1/\sqrt{0.5x0.5} = 6.32 > \alpha \text{ (underdamped)}$$

$C_o = C + 10$ mF $= 50$ mF or **40 mF**

Chapter 8, Solution 36.

For t = 0-, 3u(t) = 0. Thus, i(0) = 0, and v(0) = 20 V.

For t > 0, we have the series RLC circuit shown below.



$$\alpha = R/(2L) = (2 + 5 + 1)/(2x5) = 0.8$$

$$\omega_o = 1/\sqrt{LC} = 1/\sqrt{5x0.2} = 1$$

$$s_{1,2} = -\alpha \pm \sqrt{\alpha^2 - \omega_o^2} = -0.8 \pm j0.6$$

$$v(t) = V_s + [(A\cos 0.6t + B\sin 0.6t)e^{-0.8t}]$$

$$V_s = 15 + 20 = 35V \text{ and } v(0) = 20 = 35 + A \text{ or } A = -15$$

$$i(0) = Cdv(0)/dt = 0$$

$$\text{But } dv/dt = [-0.8(A\cos 0.6t + B\sin 0.6t)e^{-0.8t}] + [0.6(-A\sin 0.6t + B\cos 0.6t)e^{-0.8t}]$$

$$0 = dv(0)/dt = -0.8A + 0.6B \text{ which leads to } B = 0.8x(-15)/0.6 = -20$$

$$v(t) = \underline{\mathbf{\{35 - [(15\cos 0.6t + 20\sin 0.6t)e^{-0.8t}]\}\ V}}$$

$$i = Cdv/dt = 0.2\{[0.8(15\cos 0.6t + 20\sin 0.6t)e^{-0.8t}] + [0.6(15\sin 0.6t - 20\cos 0.6t)e^{-0.8t}]\}$$

$$i(t) = \underline{\mathbf{[(5\sin 0.6t)e^{-0.8t}]\ A}}$$

Chapter 8, Solution 48.

For $t = 0-$, we obtain $i(0) = -6/(1 + 2) = -2$ and $v(0) = 2x1 = 2$.

For $t > 0$, the voltage is short-circuited and we have a source-free parallel RLC circuit.

$$\alpha = 1/(2RC) = (1)/(2x1x0.25) = 2$$

$$\omega_o = 1/\sqrt{LC} = 1/\sqrt{1x0.25} = 2$$

Since $\alpha = \omega_o$, we have a critically damped response.

$$s_{1,2} = -2$$

Thus, $i(t) = [(A + Bt)e^{-2t}]$, $i(0) = -2 = A$

$$v = Ldi/dt = [Be^{-2t}] + [-2(-2 + Bt)e^{-2t}]$$

$$v_o(0) = 2 = B + 4 \text{ or } B = -2$$

Thus, $i(t) =$ **[(-2 - 2t)e^{-2t}] A**

and $v(t) =$ **[(2 + 4t)e^{-2t}] V**