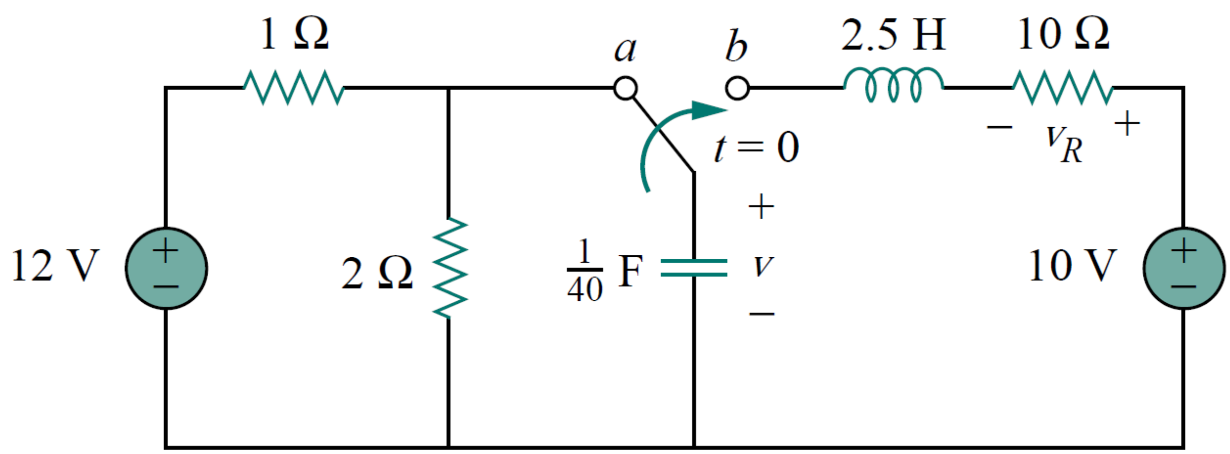
EE 202-02-Winter 2013(132)
QZ6

Sec	Ser	ID	Name



In the circuit shown above, the switch having been in position *a* for a long. At $t = 0$ time The switch is moved to position *b* .

Find $v(t)$ for $t > 0$

The initial capacitor voltage is obtained when the switch is in position a.

$$v(0) = [2/(2+1)]12 = 8V$$

The initial inductor current is $i(0) = 0$.

When the switch is in position b, we have the RLC circuit with the voltage source.

$$\alpha = R/(2L) = 10/(2x2.5) = 2$$

$$\omega_o = 1/\sqrt{LC} = 1/\sqrt{(5/2)x(1/40)} = 4$$

Since $\alpha < \omega_o$, we have an underdamped case.

$$s_{1,2} = -\alpha \pm \sqrt{\alpha^2 - \omega_o} = -2 \pm \sqrt{(2)^2 - 16} = -2 \pm j\,3.464$$

$$\text{Thus,}\quad v(t) = v_f + [(A_1\cos 3.464t + A_2\sin 3.464t)e^{-2t}]$$

where $v_f = v(\infty) = 10$, the final capacitor voltage. We now impose the initial conditions to get A_1 and A_2.

$$v(0) = 8 = 10 + A_1 \text{ leads to } A_1 = -2$$

The initial capacitor current is the same as the initial inductor current.

$$i(0) = C(dv(0)/dt) = 0 \text{ therefore, } dv(0)/dt = 0$$

$$\text{But,}\quad dv/dt = 3.464[(-A_1\sin 3.464t + A_2\cos 3.464t)e^{-2t}] \\ -2[(A_1\cos 3.464t + A_2\sin 3.464t)e^{-2t}]$$

$$dv(0)/dt = 0 - 2A_1 + 3.464A_2, \text{ which leads to } A_2 = -4/3.464 = -1.1547$$

$$\Rightarrow v(t) = \{10 + [(-2\cos 3.464t - 1.1547\sin 3.464t)e^{-2t}]\}\ \text{V}$$