Electric Circuits II – Assignment 05

#	Student ID	Student Name	Grade (10)
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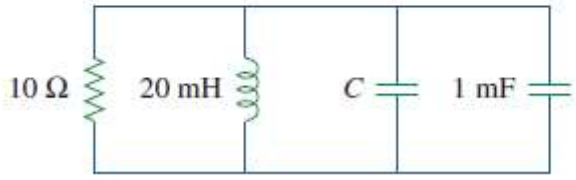
Delivery Date	

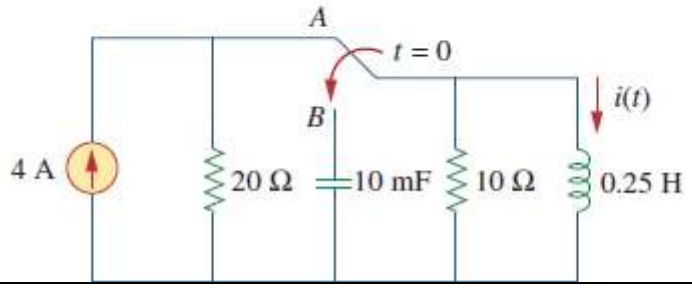
١. يتم تسليم التمرين محلولا في خلال أسبوع من تاريخ التمرين، و يتم حذف درجتين من التمرين عن كل أسبوع تأخير
٢. يتم التسليم لمعيد المقرر مباشرة
٣. تتم أجابه التمرين في نفس ورق الأسئلة

Q1	Assuming $R = 2\ \text{k}\Omega$, design a parallel RLC circuit that has the characteristic equation $s^2 + 100s + 10^6 = 0.$
Sol 1	Compare the characteristic equation with eq. (8.8), i.e. $s^2 + \frac{R}{L}s + \frac{1}{LC} = 0$ we obtain $\frac{R}{L} = 100 \longrightarrow L = \frac{R}{100} = \frac{2000}{100} = \underline{20H}$ $\frac{1}{LC} = 10^6 \rightarrow C = \frac{1}{10^6 L} = \frac{10^{-6}}{20} = \underline{50\ \text{nF}}$

Q2	For the network in Fig. , what value of C is needed to make the response underdamped with unity damping factor ($\alpha = 1$)? 
Sol 2	Let $C_o = C + 0.1$. 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 $\omega_o = 1/\sqrt{0.02x0.05} = 141.42 > \alpha$ (underdamped) $C_o = C + 1$ mF $= 50$ mF or $C =$ **49 mF**

Q3

The switch in Fig. moves from position A to position B at $t = 0$ (please note that the switch must connect to point B before it breaks the connection at A, a make-before-break switch). Determine $i(t)$ for $t > 0$.



Sol 3

When the switch is in position A, the inductor acts like a short circuit so

$$i(0^-) = 4$$

When the switch is in position B, we have a source-free parallel RCL circuit

$$\alpha = \frac{1}{2RC} = \frac{1}{2x10x10x10^{-3}} = 5$$

$$\omega_o = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{\frac{1}{4}x10x10^{-3}}} = 20$$

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

$$s_{1,2} = -5 + \sqrt{25 - 400} = -5 + j19.365$$

$$i(t) = e^{-5t}\left(A_1 \cos 19.365t + A_2 \sin 19.365t\right)$$

$$i(0) = 4 = A_1$$

$$v = L\frac{di}{dt} \longrightarrow \frac{di(0)}{dt} = \frac{v(0)}{L} = 0$$

$$\frac{di}{dt} = e^{-5t}\left(-5A_1 \cos 19.365t - 5A_2 \sin 19.365t - 19.365A_1 \sin 19.365t + 19.365A_2 \cos 19.365t\right)$$

$$0 = [di(0)/dt] = -5A_1 + 19.365A_2 \text{ or } A_2 = 20/19.365 = 1.0328$$

$$\mathbf{i(t) = e^{-5t}[4\cos(19.365t) + 1.0328\sin(19.365t)]\ A}$$