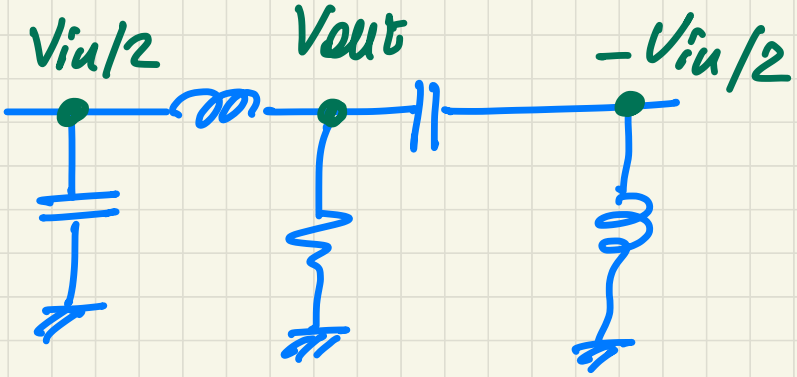
RF Circuit Design

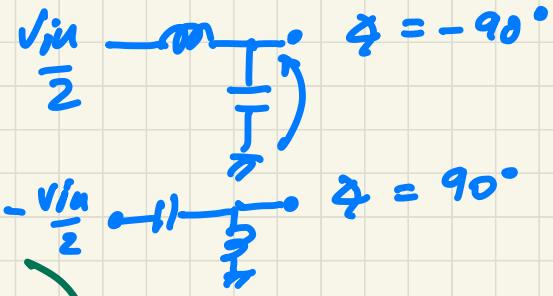
Q&A

16.04.2021

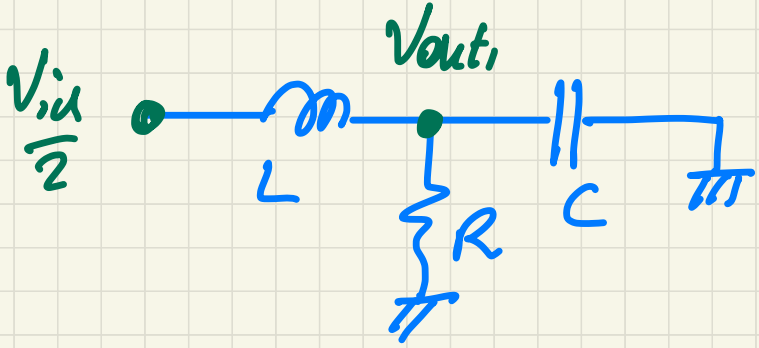
T6.4

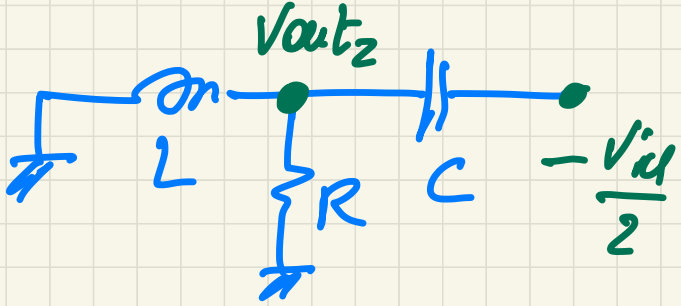
a)



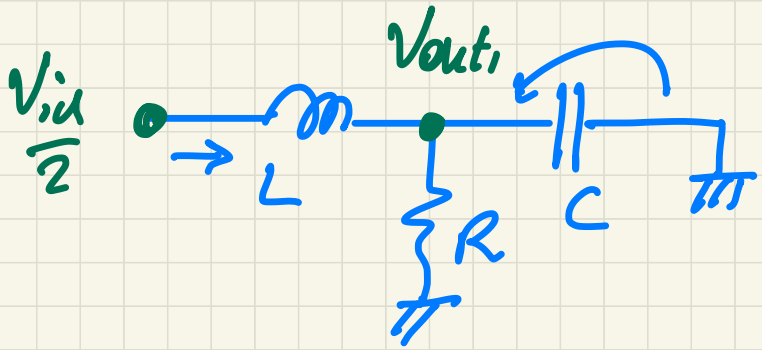


superposition principle



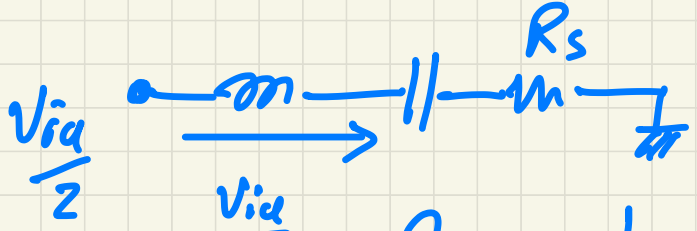


$$V_{out} = V_{out_1} + V_{out_2}$$



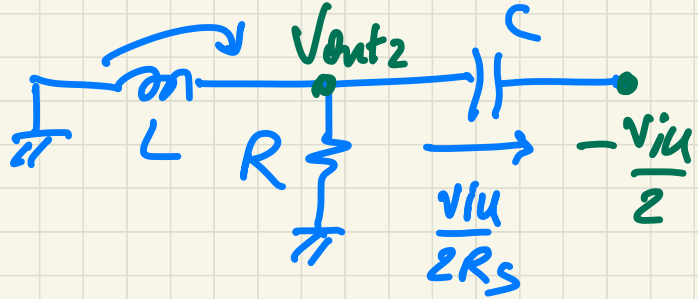
$$V_{out1} = \frac{V_{in}}{2R_S} \cdot \frac{1}{j\omega_0 C} =$$

$$\omega_0 = \frac{1}{\sqrt{LC}} \qquad = -j \cdot \frac{V_{in}}{2} \cdot Q_0$$



$$\Rightarrow V_{out} = -jQ_0 \cdot V_{in}$$

$$Q_0 = \frac{1}{\omega_0 R_S C} = \omega_0 R C = \frac{R}{\omega_0 L}$$



$$V_{out2} = -j\omega_0 L \cdot \frac{V_{in}}{2R_S} =$$

$$= -j\, Q_0 \cdot \frac{V_{in}}{2}$$

$$\left|\frac{V_{out}}{V_{in}}\right| = 1 \iff \begin{cases} Q_0 = 1 = \dfrac{R}{\omega_0 L} \\ \omega_0 = \dfrac{1}{\sqrt{LC}} = 2\pi \cdot 5 \cdot 10^9 \end{cases}$$

Solution published : → same results

$$\frac{V_{out}}{V_{in}} = \frac{R}{2}\left[\frac{1}{j\omega_0 L} - j\omega_0 C\right] \qquad \omega_0 = \frac{1}{\sqrt{LC}}$$

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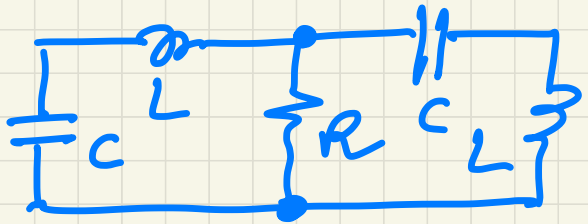
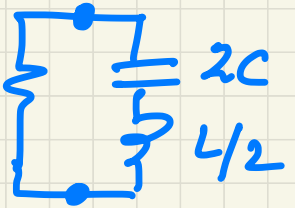
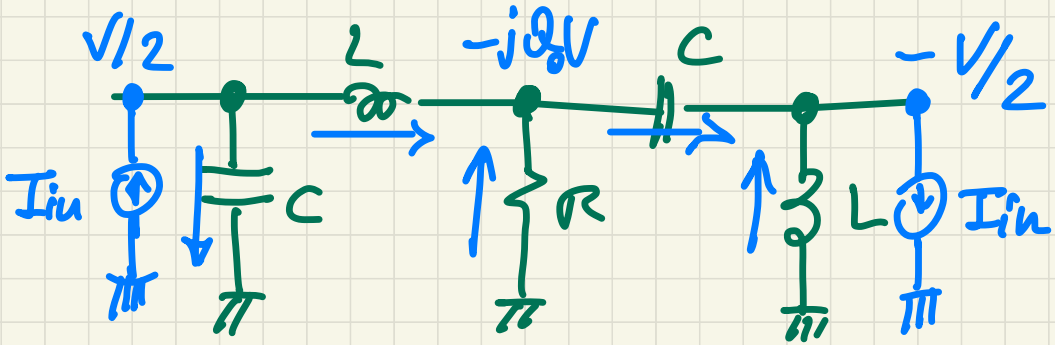




$$Q = \frac{\omega_0 L/2}{R}$$

Different Q factor



b) input impedance

$$I_{in} = j\omega C \cdot V/2 + \frac{V/2 + jQV}{j\omega L} =$$

$$Q_0 = R/\omega_0 L$$

$$= \left[j\frac{\omega C}{2} - j\frac{1}{2\omega L} + \frac{Q}{\omega L} \right] V =$$

$$\Rightarrow Z_{DIFF} = \frac{\omega_0 L}{Q_0} =$$

$$= \left[0 + \frac{Q}{\omega L} \right] V$$

$$= \frac{(\omega_0 L)^2}{R} = R \cdot Q_0^2$$