ELT-41727 Practical RF Electronics: First Principles Applied, FALL 2020

Lets study a series RLC resonance circuit. You first analyze it with paper-and-pen. Then you use AC analysis in Multisim to simulate the case.

1. Draw a series RLC resonance circuit. Find expression for the resonance frequency of the circuit.

Series RLC: The total impedance $Z_S = R + j\omega L - j\frac{1}{\omega C}$.
Resonance when for ω_r holds $\text{Imag}(Z_S(\omega_r)) = 0 \Rightarrow \left(\omega_r L - \frac{1}{\omega_r C}\right) = 0$
which gives $\omega_r = \frac{1}{\sqrt{LC}}$ and $Z_S(\omega_r) = R$.

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2. Find the resonance frequency when $L = 25$ mH, $C = 1$ nF, and R is
   (a) 1 Ω and
   (b) 100 Ω.

$R = 1\ \Omega$ and $R = 100\ \Omega\ \Rightarrow \omega_r = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{25\text{ mH } 1\text{ nF}}} = 200000$ rad
such that $f_r = 31.831$ kHz.

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3. Simulate the series resonance circuit using Multisim, look at the impedance of the circuit over frequency range 25 kHz – 40 kHz.

   In the simulations use

   - "Sweep Type" as "Decade"
   - "Number of points per decade" (at least) 200
   - "Vertical scale" as logarithmic

   (a) Explain first briefly how to relate the two plots that appear in the screen.
   (b) Compare the amplitude plots for the these two cases. You are likely to find useful "Zoom in Area"-command.
   (c) Which differences you notice between the two cases?

Following links are likely useful for you in question 3:

- `http://digital.ni.com/public.nsf/allkb/9F8D30235DE3EC0186257592006B23A2`
- `http://www.ni.com/tutorial/12690/en/`.

Simulation result with R=100 ohms