

Prelab – Experiment 6

Fourier Analysis of a Square Wave

Read the lab instructions thoroughly and then answer the following questions:

1 Question 1

(a) For the resonant filter circuit shown in Fig. 1 of the lab instructions, calculate the capacitance, C_0 , required for resonance at $f_0 = 3 \text{ kHz}$ with $L = 20 \text{ mH}$ and $R = 40 \Omega$

(b) Show that the capacitance required for resonance at frequency $f_n = nf_0$ is $C = C_0/n^2$, where n is a harmonic integer (L and R stay fixed)

2 Question 2

(a) For the resonant filter circuit in Fig. 1, show that

$$v_{\text{in}} = v_T \frac{R + j(\omega L - \frac{1}{\omega C})}{R(1 + R_T/R) + j(\omega L - \frac{1}{\omega C})}$$

where v_T and R_T are the Thevenin equivalent parameters for the voltage source, R_1 and R_2

(b) What are v_T and R_T/R for $V_0 = 5 \text{ V}$, $R_1 = 50 \Omega$, $R_2 = 4.7 \Omega$, and $R = 40 \Omega$?

(c) Suppose R_2 is removed from the circuit. What is R_T/R if $R_1 = 50 \Omega$ and $R = 40 \Omega$?

(d) Which makes v_{in} nearly independent of frequency, case (b) or case (c)?

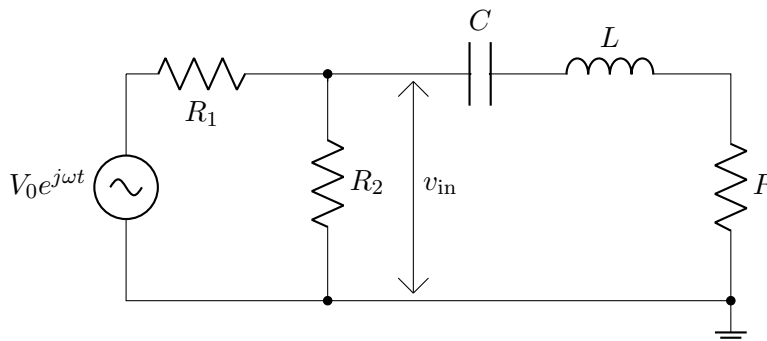


Figure 1: Resonant filter with finite impedance voltage source