## Homework #5: Phys 4321: Prof. Olness Spring 2025

1) Consider a circuit with a resistor (R), capacitor (C), or inductor (L), and this is driven by an AC source: V sin[w t]. (If you prefer, you can use an exponential form.) For an RLC circuit with R=20 ohms, C=10uF, L=100mH, and V=100 volts plot the current as a function of w.

a) Find the maximum value of the current.

b) Also, find the values of w where the current is <sup>1</sup>/<sub>2</sub> the maximum value.

c) Overlay plots for R=20,10,5 ohms and comment.

d) Is there a value of w that will make the current go to infinity???

2) a)Design an RLC circuit to tune to a particular station/frequency. Choose L and C sensibly.

b) Determine  $R_0$  so that the current at the neighboring station is =10% of the peak.

- c) Plot the current vs. R<sub>0</sub>. Find the FWHM of the signal.
- d) Plot the current vs.  $R_0$ ,  $2R_0$ ,  $(1/2)R_0$ .

Damondre: Pick an AM radio station Josh: Pick an FM radio station Luke: Pick a UHF TV station Burak: Your choice ... maybe a 2.5Gh WiFi band

3) Fourier Series:

a) Working on the Interval  $[0, 2\pi]$ , using exponentials, compute the Fourier coefficients of the step function: f=1 for  $[0, \pi]$ , and f=1 for  $[\pi, 2\pi]$ .

b) compute the Sin and Cos coefficients.

c) Plot the Fourier expansion of Sin+Cos with {1,3,5, 10, 100} terms.

d) Repeat with just the Sin terms.

e) Repeat with just the Cos terms.

4) Fourier Series:

Repeat #3 for a sawtooth function: f[x] = x for  $[0, 2\pi]$  periodic.