ECE 2260 **LAB 2 Oral Presentation Contents** THE UNIVERSITY OF UTAH

Each student must make one oral presentation in lab during the semester.

Each presentation will last **five minutes** and will be made in the order listed at the beginning of the lab session. The presentations will describe work performed the previous week in lab by way of review. Practice your talk and be succinct. Stick to the five-minute time frame.

Week 2 of lab:
Presentation 2.1: Entire filter response

a) Explain that your presentation will discuss the frequency response of the complete filter used in Lab 2.
b) Draw Fig. 1 from Lab 2 on the board. (Draw parts (a) and (b) of the figure.)
c) Tell the listeners that you will be ignoring R_s and C_s.
d) Explain what the amplitude of v_o at $\omega = 0$ and $\omega \rightarrow \infty$ will be.
e) Explain why the amplitude of v_o at some intermediate frequency will be zero.
f) Explain why the amplitude of v_o at some higher intermediate frequency will be equal to the amplitude of v_g. (Show that L and C_2 act somewhat like an L above the resonant frequency of L and C_2.)
g) Sketch the entire gain function $|H(s)| = \left|\frac{V_O(s)}{V_S(s)}\right|$ versus ω based on the previous results.

Presentation 2.2: Inductor parameters

a) Explain that your presentation will cover the mathematical behavior of the inductor impedance, z_L, so the effects of parasitics on v_o may be determined later in the lab.
b) Redraw Fig. 1b from Lab 2 (if necessary) on the board.
c) List the parameters of inductor that were measured: L, R_s, C_s.
d) Draw a plot showing the general shape of the magnitude of the inductor impedance, $|z_L|$, versus ω with and without R_s and C_s. Explain why C_s is important in Lab 2.
e) Explain how R_s will affect the value of ω where the maximum of $|z_L|$ occurs.

Presentation 2.3: Inductor measurement

a) Explain that your presentation will cover the measurement of the inductor impedance, z_L.
b) Explain the rationale used to measure the value of C_s. (That is, refer to the peak of $|z_L|$ that occurs near the resonant frequency for $sL \| -j/sC_s$.)
c) Draw a picture of how instruments were connected to the inductor (and extra resistor) to find the resonant frequency of the inductor.
d) Explain what the resistor was for, and how its value was determined.
e) Explain how the measurement of the resonant frequency was made.
f) Give the value of resonant frequency you measured.

Presentation 2.4: Matlab™ for Fourier series

a) Explain that your presentation will describe how to write Matlab™ code for summing a Fourier series.
b) Draw pictures of sinusoids found in the Fourier series for a square wave, and describe the process of summing the sinusoids a one point in time. In other words, discuss what calculations must be performed and what information is required for the calculation.
c) Point out that the calculation at one point in time will be repeated for many discrete points in time, with the results connected by line segments to show the final waveform versus time.
d) Write down code for calling a function that calculates a Fourier sum for the square wave, (i.e., that calculates a waveform from Fourier coefficients). Indicate what the arguments to the function do.
e) Show the skeleton of the code for the Fourier sum function itself. Show the first line of code for the function. Also indicate the "for" loops that must be calculated (for coefficients and for points in time) and describe what is calculated in the loops.
f) Note what is returned from the function (i.e., the waveform values at the points in time).

Presentation 2.5: Matlab™ output for triangle wave

a) Explain that your presentation will discuss the triangle waveform that is output by the Matlab™ Fourier sum code.
b) Draw the triangle waveform and write down the Fourier series for it. (Coefficients are listed inside the back cover of the course text.)
c) Explain how you decided how many terms you used in the Fourier series and why. (Consider the magnitude of coefficients versus frequency.)
d) Write down the commands used in Matlab™ to create the array of coefficients for the triangle wave, (i.e., the arrays that are passed to the Fourier sum function).
e) Show the plots of the triangle waveform when you pass only three nonzero coefficients and when you pass many nonzero coefficients to the Fourier sum function.
f) Explain the shapes of the plots shown in (e). In particular, explain what features of the waveform the higher frequency terms influence.

Presentation 2.6: Phasors and Fourier series

a) Explain that your presentation will describe how to obtain the Fourier series of a filter's output given the Fourier series of the filter's input.
b) Draw the filter circuit for Lab 2 on the board, (showing the inductor without the parasitic components).
c) Write the following on the board:

   Generic Fourier series for input $v_s(t) = a_v + \sum_{k=1}^{\infty} a_k \cos(k\omega_0 t) + b_k \sin(k\omega_0 t)$

   Fourier series for the triangle wave input

   Generic Fourier series for output $v_0(t) = a'_v + \sum_{k=1}^{\infty} a'_k \cos(k\omega_0 t) + b'_k \sin(k\omega_0 t)$
d) Explain what the phasor is for each term of each Fourier series in (c). (For the generic input, the phasor for the kth harmonic is $a_k - jb_k$, for example.)
e) Explain that the filter output for the kth harmonic is $(a_k - jb_k)H(s)$ where $s = j\omega_0$.

Presentation 2.7: Estimating filter output by coeff magnitude * H magnitude

a) Explain that your presentation will describe how to estimate the shape of the filter output waveform based on Fourier coefficients of the input multiplied by the filter transfer function magnitude (i.e., gain).

b) Explain that the magnitude of the output phasor (for a given harmonic in the Fourier series of the input) is equal to the magnitude of the phasor for that harmonic of the Fourier series of the input multiplied by the magnitude of the filter transfer function for that harmonic frequency.

c) Draw a plot of the filter gain versus frequency (blocks 1 kHz and passes 3 kHz) on the board and write the Fourier series for the 1 kHz input triangle wave.

d) Using the information from (c), estimate the magnitude of the phasor for the output for frequencies of 1 kHz, 3 kHz, and 5 kHz.

e) Given the result of (d), sketch what the output waveform should look like. In other words, show the expected sum of the output waveforms for the 1 kHz, 3 kHz, and 5 kHz harmonics.

Presentation 2.8: Shapes of output waveforms predicted for 3.B.2

a) Explain that your presentation (like the previous one) will describe how to estimate the shape of the filter output waveform based on Fourier coefficients of the input multiplied by the filter transfer function magnitude (i.e., gain). Your talk, however, will apply that method to predict the waveform for part 3.B.2.

b) Recap the idea that the magnitude of the output phasor (for a given harmonic in the Fourier series of the input) is equal to the magnitude of the phasor for that harmonic of the Fourier series of the input multiplied by the magnitude of the filter transfer function for that harmonic frequency.

c) Draw a plot of the filter gain versus frequency for the component values given for part 3.B.2 (blocks 1.2 kHz and passes 3.6 kHz) on the board and write the Fourier series for the 1 kHz input triangle wave.

d) Using the information from (c), estimate the magnitude of the phasor for the output for frequencies of 1 kHz, 3 kHz, and 5 kHz.

e) Given the result of (d), sketch what the output waveform should look like. In other words, show the expected sum of the output waveforms for the 1 kHz, 3 kHz, and 5 kHz harmonics.

Presentation 2.9: Actual gain vs predicted

a) Explain that your presentation will discuss how the parasitics affect the Lab 2 circuit's performance.
b) Show the effect of R_s on the circuit at 1 kHz by calculating the impedance for C_2, L, and R_s (leaving out C_s).
c) Based on the result from (b), calculate what the gain of the circuit is for the value of R_1 you chose to use, and comment on what value of R_1 is best.
d) Repeat part (b) for 3 kHz but also include C_1 (still leaving out C_s).
e) Comment on what effect R_s has on the shape of the gain versus frequency for the circuit.

Presentation 2.10: 9 kHz vs 1 kHz reject filters

a) Explain that your presentation will describe the differences in performance observed for the 9 kHz and 1 kHz reject filters.
b) Draw Fig. 1 from Lab 2 on the board. (Draw parts (a) and (b) of the figure.)
c) Explain how you derived the values of C_1 and C_2 for the 9 kHz case. (The basic idea is that the resonance of C_2 and L shorts the output at 9 kHz instead of 1 kHz, and that the resonance of C_1 and L+C_2 (which looks inductive for frequencies above 9 kHz) looks like an open circuit at 27 kHz.)
d) Give the values of C_1 and C_2 for both the 1 kHz and 9 kHz cases.
e) To explain the effect of C_s on the circuit at 1 kHz and 9 kHz, calculate the value of the impedance for the L model with and without its parasitics at 1 kHz and 9 kHz. Comment on which frequency has the higher percentage error for the L impedance resulting from parasitics.

Presentation 2.11: Recap Lab 2 part I

a) Explain that your presentation will summarize the results of Lab 2.
b) Draw Fig. 1 from Lab 2 on the board. (Draw parts (a) and (b) of the figure.)
c) Sketch the filter gain versus frequency.
d) Explain why the filter blocks 1 kHz and passes 3 kHz. In particular, explain that the resonance of C_2 and L shorts the output at 1 kHz, and that the resonance of C_1 and L+C_2 (which looks inductive for frequencies above 1 kHz) looks like an open circuit at 3 kHz.
e) Explain what approximate output waveform the circuit will produce for a 1 kHz triangle-wave input, and why.

Presentation 2.12: Recap Lab 2 part II

a) Explain that your presentation will describe the effects of the parasitics on the performance of the Lab 2 circuit.
b) List the values of parasitic components that you obtained.
c) Show plots for the filter output comparing the circuit with an ideal inductor (no parasitics) to the circuit with the actual inductor.
d) Explain the results from (c).