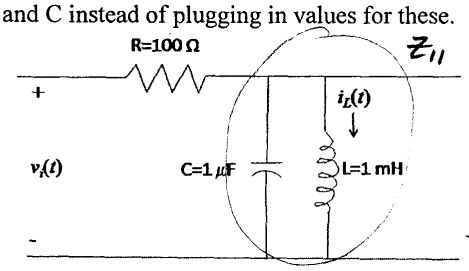
Name: Key

Section: _____

EE322 Fall 2010 Exam 2: Part 2

- You will have the remainder of the lab period to take Part 2 of the exam.
- This portion of the exam is closed book/notes/calculators, but you are free to use MATLAB and MATLAB help as needed.

5. (10 pts) Given the circuit below, determine the equation for the system's frequency response, $H(j\omega)$, if the input is $v_i(t)$, and the output is the current through the inductor, $i_L(t)$. Leave your answer in terms of R, L and C instead of plugging in values for these.



$Z_{11} = \frac{Z_L Z_C}{Z_L + Z_C}$

$Z_{11} = \frac{\frac{1}{j\omega C} \cdot j\omega L}{\frac{1}{j\omega C} + j\omega L}$

$Z_{11} = \frac{j\omega L}{(j\omega)^2 LC + 1}$

use voltage divider

$$H(j\omega) = \frac{I_L(j\omega)}{V_i(j\omega)} = \frac{\frac{V_{LC}(j\omega)}{j\omega L}}{V_i(j\omega)} = \frac{V_i(j\omega)\,\frac{Z_{11}}{R+Z_{11}} \cdot \frac{1}{j\omega L}}{V_i(j\omega)}$$

$$H(j\omega) = \frac{Z_{11}}{R+Z_{11}} \cdot \frac{1}{j\omega L} = \frac{\frac{j\omega L}{(j\omega)^2 LC+1}}{R + \frac{j\omega L}{(j\omega)^2 LC+1}} \cdot \frac{1}{j\omega L} \cdot \frac{(j\omega)^2 LC+1}{(j\omega)^2 LC+1}$$

$$\boxed{H(j\omega) = \frac{1}{(j\omega)^2 RLC + j\omega L + R}}$$

(Turn this page over)

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6. (15 pts) Programming.

a. Write a MATLAB program that will display the magnitude and phase of the frequency response of this filter in a single figure window (that is, using the *subplot* command), with magnitude in the upper plot and phase in the lower plot. Plot your frequency axis in f (Hz) using a frequency vector from -10,000 Hz to +10,000 Hz. Put your phase plot in degrees. Turn in your code and a well-labeled plot.

b. Using your plot: BPF

-What type of filter is this (LPF, HPF, BPF, BSF)? Why?

there is a resonant freq which has the max Gain, and gain ↓ as freq increases or decreases from resonant freq.

-If it is a low pass or high pass filter, use your magnitude plot to determine the cutoff frequency. If it is a band pass or band stop filter, what is the resonant frequency?

Cutoff frequency = _____ OR Resonant frequency = ~4905 Hz

-From your plots, what is the approximate ½ power bandwidth in Hz (zoom in as needed to obtain reasonably accurate values)? State how you determined your answer, and show it on your plot.

½ pwr bandwidth is determined by where $|H(j\omega)|$ drops to .707 of it's max value. Since max value of $|H(j\omega)|$ is 0.032, find the 2 freqs where Gain is (.707)(.032) = .022

$f_{1+} = 5695$ Hz

$f_{1-} = 3962$ Hz

$BW_{3dB} = 1733$ Hz

Print out your code and the figure. Be sure that your name is displayed somewhere on your printouts. Your name is important if multiple midshipmen are printing at the same time.


```
f=-10000:10000;
```

```
L=1e-3;,C=1e-6;R=100;
num = 1;
denom = 1e-7*(j*2*pi*f).^2 + 1e-3*(j*2*pi*f)+100;
H=num./denom;

figure(1),subplot(2,1,1),plot(f,abs(H)),grid on
xlabel('frequency (Hz)'),ylabel('|H(jw)|')
subplot(2,1,2),plot(f,180/pi*angle(H)),grid on
xlabel('frequency (Hz)'),ylabel('Phase of H(jw) (deg)')
```