Studying the Response of RLC Circuits to Sinusoidal Inputs Using Simulink

R Kwong - kwong@control.utoronto.ca, F Mansouri - farrokh.mansouri@mail.utoronto.ca

• **Name:**	**Lab Date:**	
• **Student No.:**	**Day of the week:**	**Time:**
• **Name:**	**TA Signature:**	
• **Student No.:**	**Grade:**	

1. Natural frequency of an RLC Circuit

1.1 Exercise 1.1

Calculate the natural frequency for the following systems **(1 pt)**

1. $C = 0.01, L = 0.01$
2. $C = 0.02, L = 0.01$
3. $C = 0.04, L = 0.01$
4. $C = 0.01, L = 0.02$
5. $C = 0.01, L = 0.04$

1.2 Exercise 1.2

a. *Vary the resistance values to show that damping factor increases as you increase the resistance (set C=0.01 and L=0.01). Deomstrate to TA (TA to check box)* **(1 pt)**

b. *At what resistance does the system transition from underdamped to overdamped? (Keep L=0.01 and C=0.01)* **(0.5 pt)**

c. *How would underdamped to overdamped transition change if you increase L to 0.02 and C to 0.02?* **(0.5 pt)**

2. RLC circuit response to an external voltage source

2.1 Exercise 2.1

a. *Set the amplitude of your voltage source to 1 and measure the amplitude of the response of the circuit for the following input frequencies.***(1 pt)**

1. *Natural frequency / 5*
2. *Natural frequency / 2*
3. *Natural frequency*
4. *Natural frequency * 2*
5. *Natural frequency * 5*

2.2 Exercise 2.2

Demonstrate the square wave Simulink model and explain peaks in spectrum analyzer. (TA to check box) **(1 pt)**

3. Applying Fourier Series in circuit analysis

3.1 Exercise 3.1

a. *Use a square wave with 1/32 sec period. Read the frequency of the first 4 peaks on the frequency spectrum, and record the results below.* **(0.5 pt)**

b. *Calculate the first 4 terms of the Fourier series for the square wave using the equation provided, and write down the frequency and amplitude of each term from the Fourier approximation below.* **(0.5 pt)**

c. *Demonstrate the 4-term Fourier series approximation to the square wave. (TA check box)* **(0.5 pt)**

3.2 Exercise 3.2

Compare the response of RLC circuit to the 4-term Fourier series approximation to that of the square wave. (TA check box) **(1 pt)**

3.3 Exercise 3.3

a. *Demonstrate the 8-term Fourier series approximation to the square wave. (TA check box)* **(0.5 pt)**

b. *Compare the response of RLC circuit to the 8-term Fourier series approximation to that of the square wave. (TA check box)* **(1pt)**

c. *Does the 8-term Fourier series approximate the square wave better, or does the output response with the 8-term Fourier series approximate the output response for the square wave better? (TA check box for explanation)* **(1pt)**