Departement Elektriese, Elektroniese en Rekenaaringenieurswese

Prakties 3: Inhandigingsinstruksies

Analoog Elektronika ENE310

15 Junie 2020

Department of Electrical, Electronic and Computer Engineering

Practical 3: Submission Instructions

Analog Electronics ENE310

15 June 2020

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
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ASSESSMENT ID: 2020ENE310R03

This document outlines how practical 3 will be submitted. Please read carefully. Unlike practical one and two, **practical three will not be submitted as a PDF report**. The changes to the format will assist the teaching staff to find the relevant information more quickly and ultimately facilitate quicker feedback.

The submissions for practical 3 are organised in 2 parts. The first is an Excel submission and the second is the submission of specifically selected figures of your circuit schematics and simulation results. **Please make sure that you follow the naming convention for each JPG upload *exactly*.** The AMS will not know what to do with the figure if it does not have a valid name.

AMS Excel Submission

Oscillator Design

1.1-1.4 [10]

Design your oscillator and complete the AMS Excel file with the final answers for your component values. The circuit diagram is given below.
Fill in the values for

- R_1
- R_2
- Z_1 (Specify the type of component and its calculated value)
- Z_2 (Specify the type of component and its calculated value)
- Z_3 (Specify the type of component and its calculated value)
- Z_4 (Specify the type of component and its calculated value)
- f_o: the oscillating frequency in Hz
- The impedance of your tank
- The quality factor of your tank

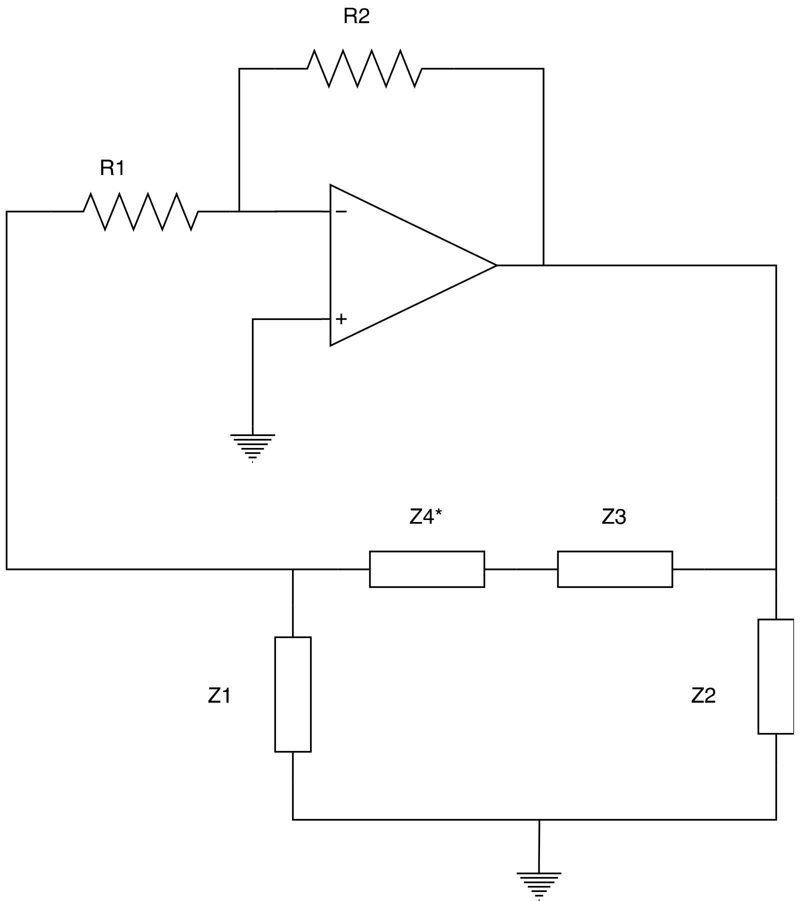


Figure 1: Oscillator type 1

Note *: X4 is present in the Clapp configuration. X4 must reference the capacitor.

1.5 [3]

Calculate the THD of your oscillator 1. Enter the magnitude of the fundamental frequency and the first 5 harmonics.
NOTE: The magnitude of the fundamental and the harmonics must correspond to the FFT given in question 2.3.

2.1-2.3 [10]

Design your oscillator and fill in the AMS excel file. The circuit diagram is given below.

Fill in the values for

- R_1
- R_2
- R_3 (or $R_{G)}$
- Z_1 (Specify the type of component and its calculated value)
- Z_2 (Specify the type of component and its calculated value)
- Z_3 (Specify the type of component and its calculated value)
- Z_4 (Specify the type of component and its calculated value)
- f_o: the oscillating frequency in Hz
- The impedance of your tank
- The quality factor of your tank

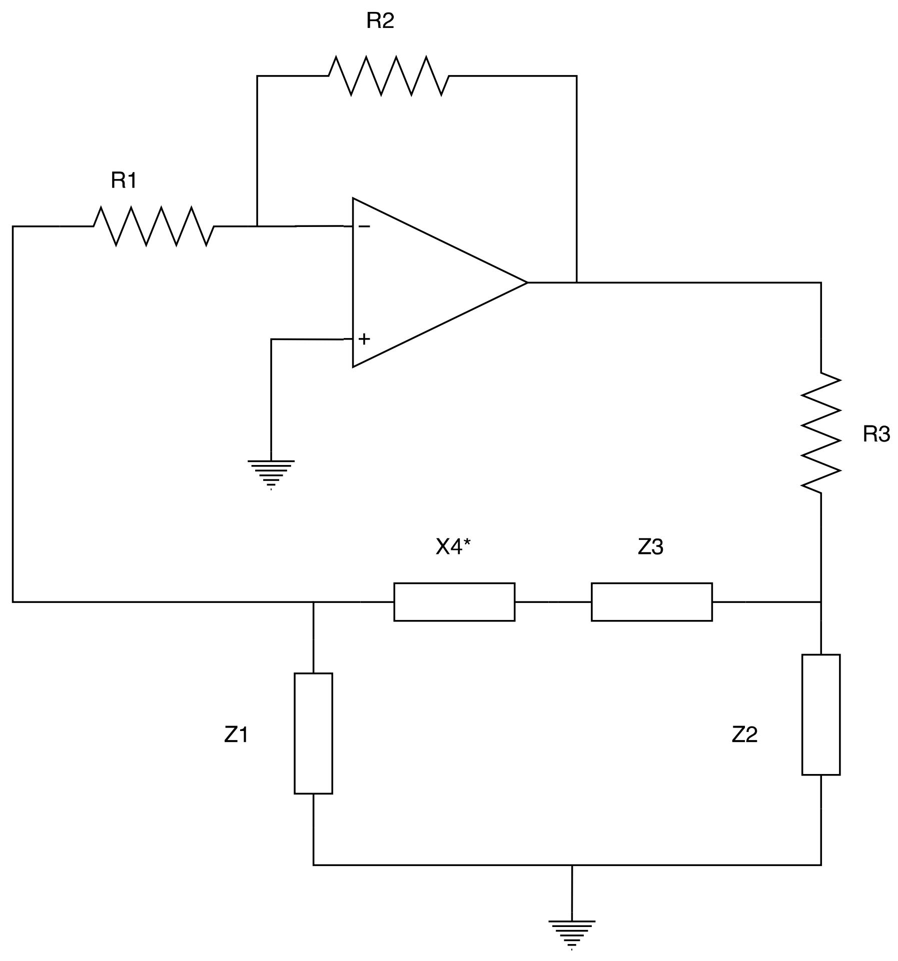


Figure 2: Oscillator type 2

Note *: X4 is present in the Clapp configuration. X4 must reference the capacitor.

2.4 [3]

Calculate the THD of your oscillator 2. Enter the magnitude of the fundamental frequency and the first 5 harmonics.
NOTE: The magnitude of the fundamental and the harmonics must correspond to the FFT given in question 2.3.

3 [18]

Complete the table below in the excel submission

The first line for R1 is filled in as an example and is not necessarily correct.

Component	Change Type	Oscillating Frequency	Tank Impedance	Quality Factor	Time till start-up	THD
R1	Increase	No effect	Decreases	No effect	Decreases	Increases
	Decrease	Increases	Increases	No effect	No effect	No effect
R2	Increase					
	Decrease					
R3	Increase					
	Decrease					
Z1	Increase					
	Decrease					
Z2	Increase					
	Decrease					
Z3	Increase					
	Decrease					

4 [15]

Conclude on what you have noticed in the practical. Write your conclusion in the excel submission.

4.1) Did your oscillator work as expected? Did your need to tune it before it worked correctly? How did its performance compare to theory?

4.2) Is a higher Q or lower Q desired in the Oscillator? How would Q change if your reactive components have parasitic losses

4.3) How can you ensure the oscillator starts and why is it different in simulation than in real life?

4.4) What was the THD of your LC oscillator? Describe any reasons that may have caused the THD.

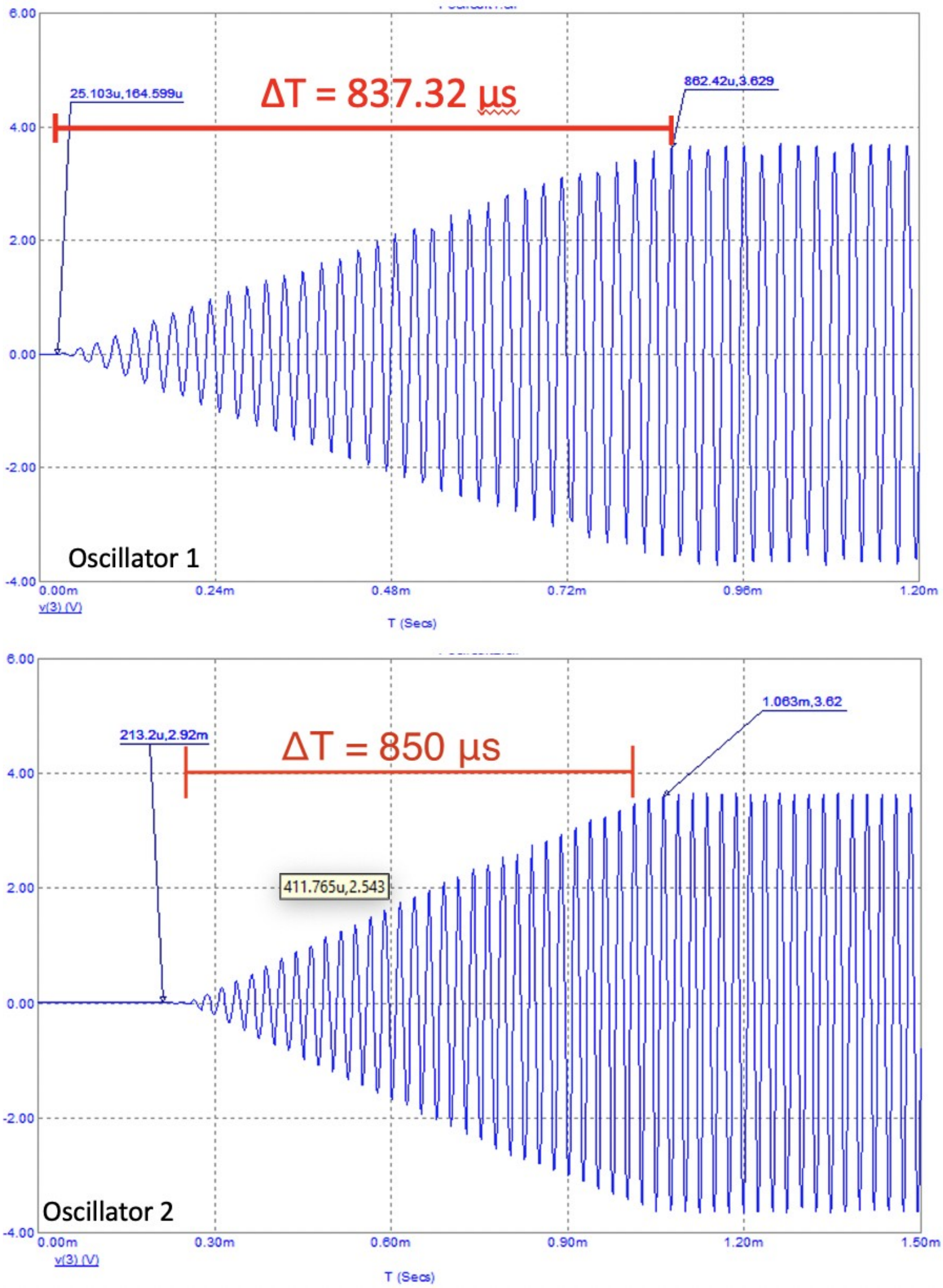
4.5) What was the THD of your circuit in Part 2 (multivibrator, triangular wave generator, etc.)? How does it compare to that of the LC oscillator's sinusoidal wave output? Describe any reasons that may have caused the THD.

AMS JPEG Submission [20]

Oscillator Simulations

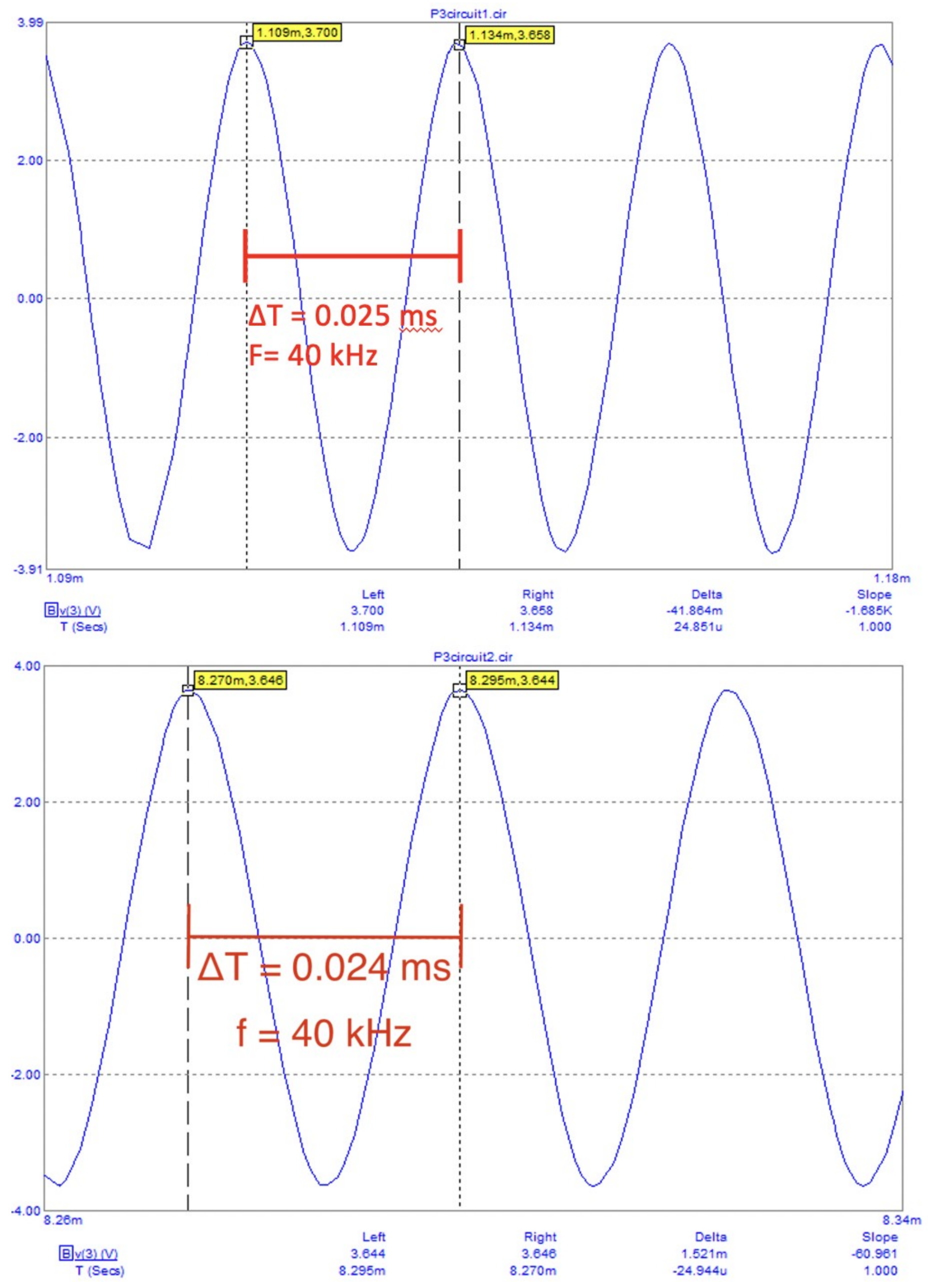
5.1 [3]

Upload a figure outputs (as a single JPEG) of the transient simulations showing both your ‘oscillator 1’ (see slide 9) and your ‘oscillator 2’ starting up . Annotate the time it took for both oscillators to start up to highlight differences (if any). If you used a disturbance, the time should be measured from when the disturbance is applied until full the voltage swing is reached. Use the figure below as an example of what to show. **Name this figure “LC_startup.jpg”.**



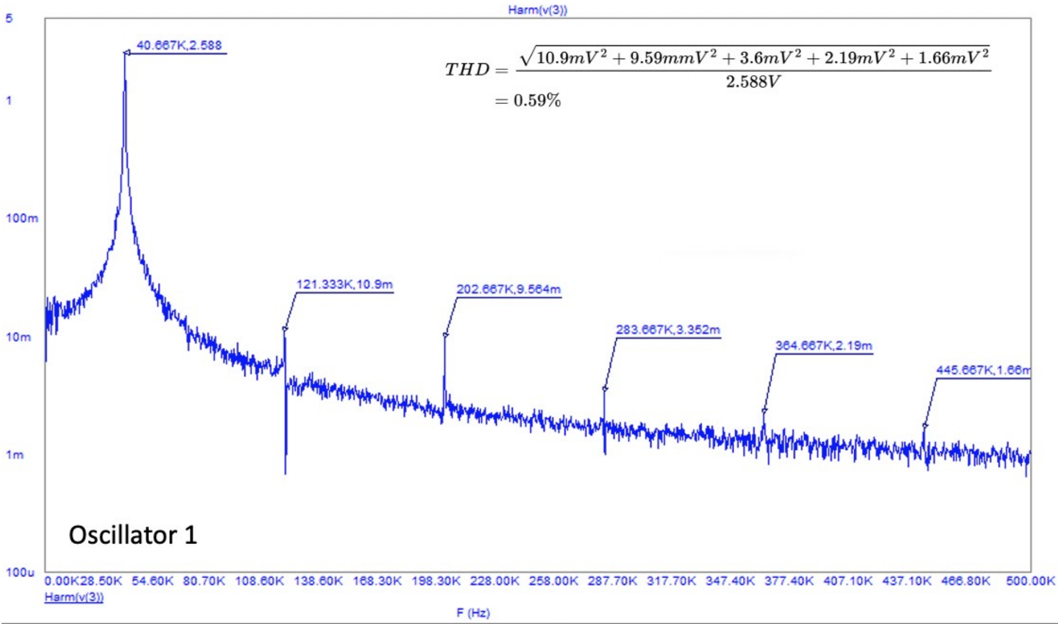
5.2 [3]

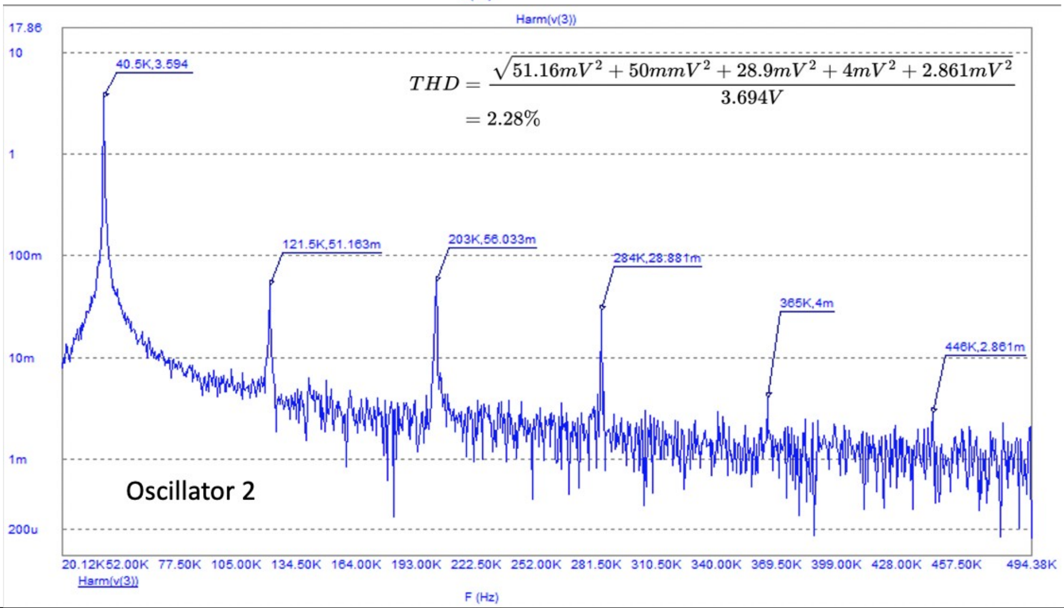
Upload a figure of the transient simulations showing at least three periods of both ‘oscillator 1’ and ‘oscillator 2’ after is has reached it full voltage swing. Measure the time of one period and calculate the frequency of oscillation. Also indicate the amplitudes. Use the figure below as an example of what to show. **Name this figure “LC_tran.jpg”.**



5.3 [3]

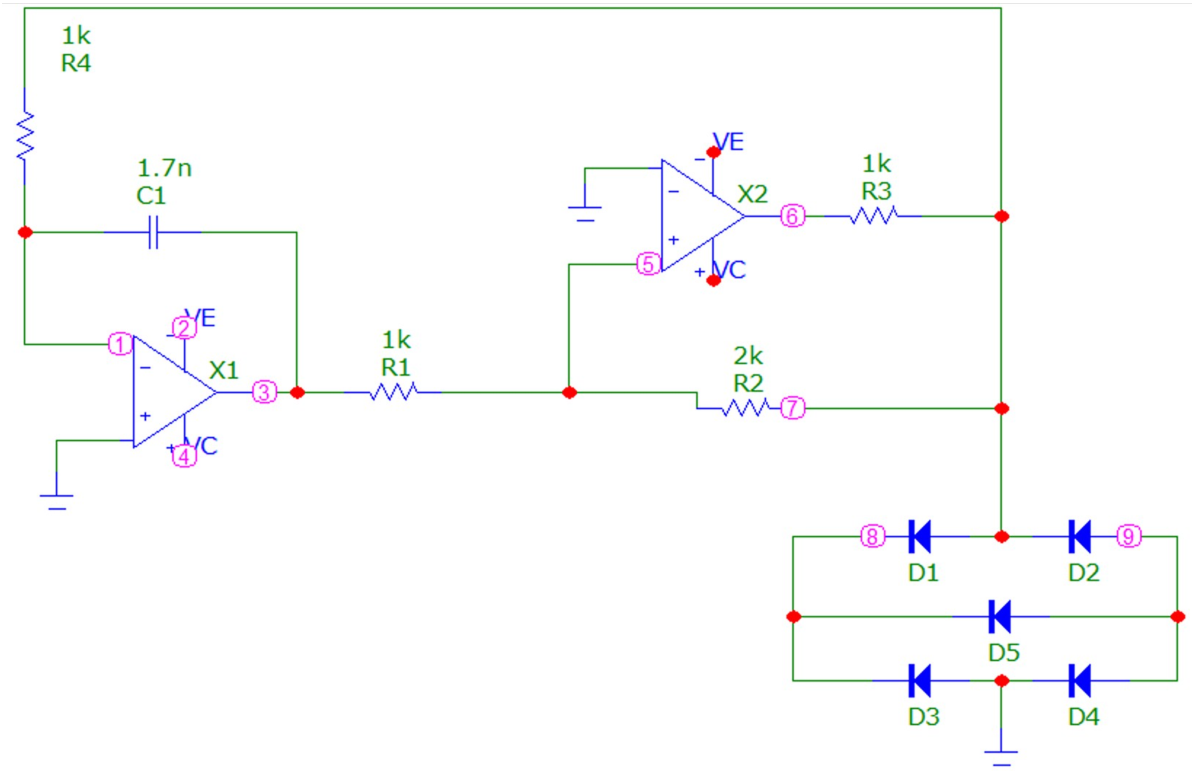
Upload a figure of an FFT of your ‘oscillator 1’ and your ‘oscillator 2’ outputs as a single JPEG file. Mark the fundamental and harmonics (if any) on the figure. It should be clear from the figure if there is/is not any advantage of using one oscillator over another when THD is considered. Use the figure below as an example of what to show. **Name this figure “LC_fft.jpg”.**





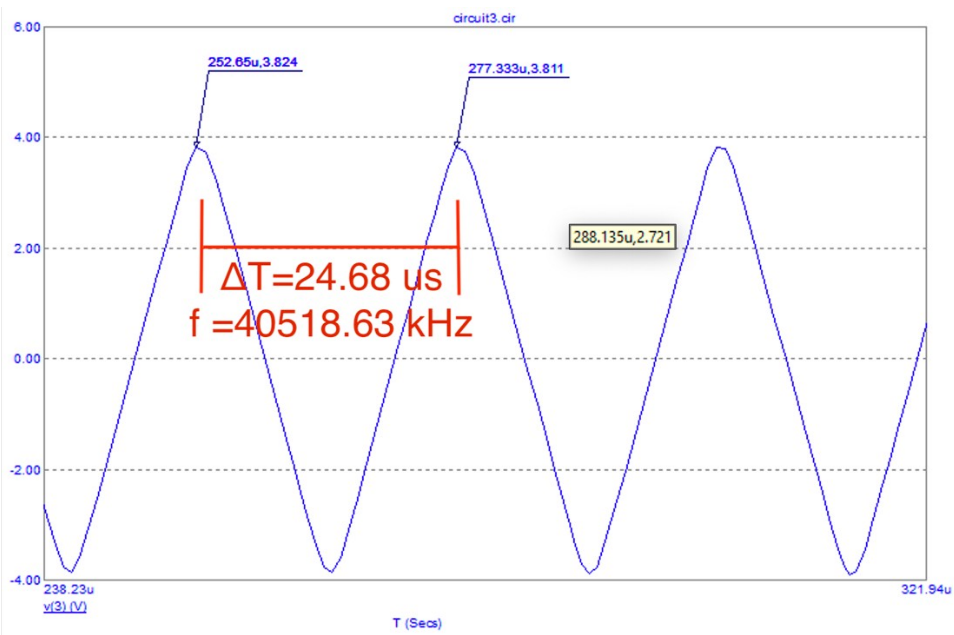
5.4 [5]

Upload a figure of the circuit schematic of your **multivibrator** (or other allowed choice) in your simulator environment. Use figure 4 below as an example of what to show**.** Remember you can show any allowed circuit, it does not have be the same as the example. Marks are awarded based on complexity, with 50% - 75% given for simple to complex circuits from the textbook, and 75+% awarded for circuits not in the textbook. **Name this figure "Part2_schematic.jpg"**.



5.5 [3]

Upload a figure of a transient simulation showing at least three periods of the circuit's output you have chosen after it has reached the full voltage swing. Measure the time of one period and calculate the frequency of oscillation. Annotate the figure showing your calculated oscillation frequency. Use figure 4 below as an example of what to show. **Name this figure "Part2_tran.jpg"**.



5.6 [3]

Upload a figure of a FFT of the output of your selected circuit for Part 2. Mark the fundamental and harmonics (if any) and annotate the calculation for THD on the figure. Use the figure below as an example of what to show. **Name this figure "Part2_fft.jpg".**