Project - Due Date: TBD

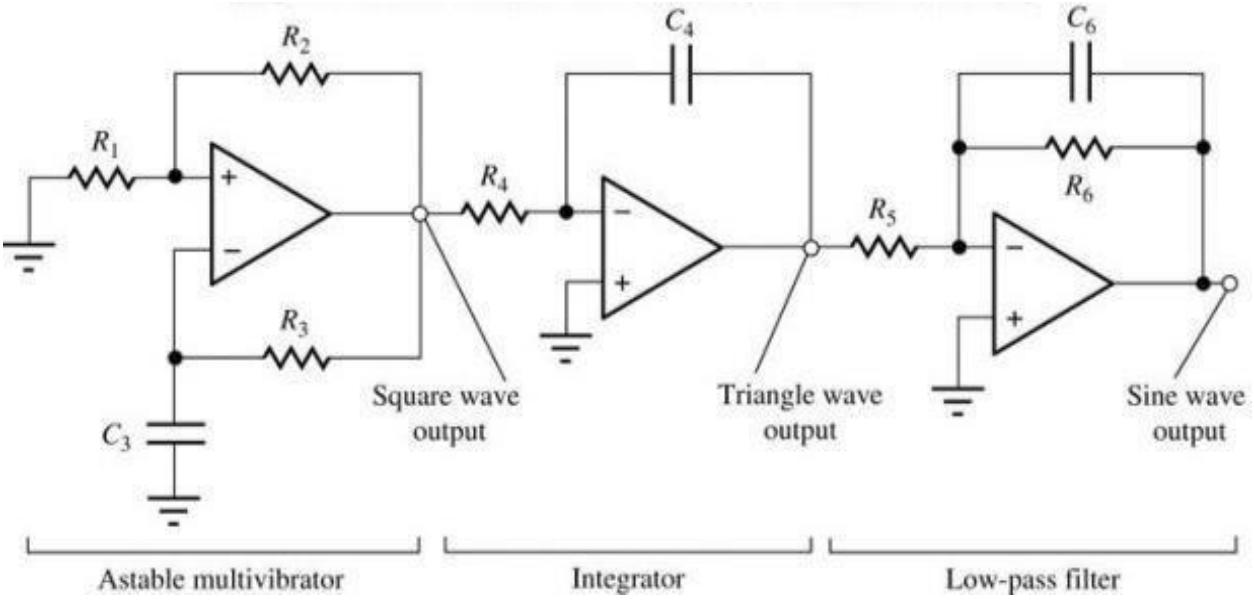
Submission Notes:

- This project can be done in groups of 4 students or less.
- Project grade will be based on the submitted report; any copied reports will be given **Zero**.
- You should provide the required simulations using **CADENCE**.
- The report is limited to 10 pages without the cover, half a point will be lost for each extra page.
- Project submission will be an email containing a pdf as an attachment to elc3010.analog.assignments@gmail.com
- The cover page must contain the group names in Arabic and their ID's.
- All graphs and figures should be clear with readable axes and traces.
- If the students participating in the project ID's are: 9202293, 9202162, 9202038 & 9202125 then the report name should be "9202293 & 9202162 & 9202038 & 9202125".
- If you submit before Monday 26th December at 11:59 pm, you will get a **bonus of 2 marks**.

Analog Function Generator:

You are required to simulate a simple function generator using the astable multi-vibrator to generate the square wave. The function generator should be able to generate square, triangular, and sine waveforms with a frequency range from 10kHz to 1MHz.

Analog Function Generator Functional Block Diagram:



Circuit Description:

The above circuit consists of three stages:

- **Astable Multi-vibrator:**
  - Uses positive and negative feedback to generate square wave output.
  - Frequency is varied by changing R3 and/or C3.
- **Lossless Integrator**
  - Driven by the output of the astable multi-vibrator to produce a triangular waveform.
- **Low-pass Filter**
  - The output of the integrator is then passed through a low-pass filter to produce a low-distortion sine wave.

Requirements:

1. Determine the values of the passive elements (resistors and capacitors) to generate output frequencies from 10kHz up to 1MHz. (show your analysis and design choices)
2. Simulate the schematic of the function generator using a model for the op-amps to have a gain and BW (you can use voltage controlled voltage source with gain=10,000 and a first order RC network to set the BW=10MHz).
3. Plot the output waveforms from the three stages showing the minimum and maximum frequencies.
4. Show the purity of the output sine wave using Discrete Fourier Transform (DFT) and total harmonic distortion (THD) in dB.
   - Show clearly the definition of THD and how to get the value of THD from the DFT.
5. Change the gain of the ideal operational amplifiers (to be 1000 & 100) and show the effect on #3 & #4.
6. Change the BW of the ideal operational amplifiers (to be 1MHz & 1KHz) and show the effect on #3 & #4.
7. Discuss your results