Mini Project #1: Design and Implementation of a Biquad

This project can be done in groups of **2 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**.

All the equations derivations should be written in **WORD.**

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**.

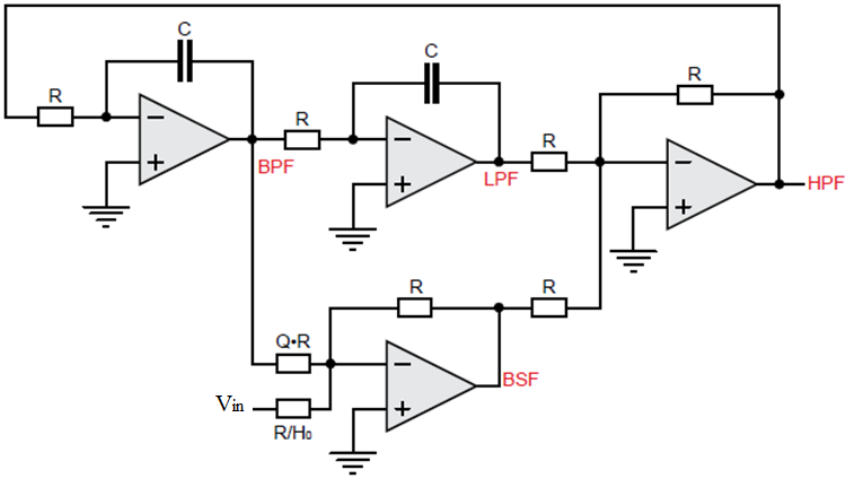
All graphs and figures should be clear with readable axes and traces.

If the students participating in the project ID's are: 9202293, 9202162 then the report name should be "9202293 & 9202162".

The project is due on **Tuesday April 11th, 2023 at 23:59**.

Universal Biquadratic Filter:

For the shown Universal Biquadratic section, **derive** different transfer functions at different OpAmp outputs and verify their types (LPF, BPF, HPF, and BSF).



Step 1: **Design** R & C to obtain f_0=1 MHz, Q=2.2, H_0=1. (Choose components with reasonable values).

Step 2: **Simulate in Cadence** the Universal Biquadratic section using ideal OpAmps (voltage controlled voltage source VCVS with a gain of 10,000 and V_{max}=1V and V_{min} = -1V). (No need to limit the bandwidth of the used ideal OpAmps).

- **Show** the schematic of your design showing values of R & C.
- **Plot** the frequency response (magnitude & phase) for all 4 outputs showing f_o, Q, and H_o. Show how each value can be calculated from the plotted response.
- **Apply** an input sine-wave at 1MHz and show the transient LPF and HPF outputs. Compare with the frequency response (magnitude & phase) of these two filters.
- **Apply** an input square-wave at 1MHz and show the transient BPF and BSF outputs. Comment on the reasons for the obtained response
- **Any missing item from the items above will be penalized in the report grading.**