Lab 1: Introduction to Digital Oscilloscopes

The purpose of this lab is to get yourself used to the lab equipment.

Read the document *Digital Oscilloscope Principles* on Moodle before the Lab.

Lab Work:

In the lab, please do each task in order. At each step take photographs of your results to put them in your reports. After each step, you need to get the approval of your TA, so do not move on if you will lose the results until your TA sees them.

1. Use the compensation signal of the oscilloscope and compensate your probes as explained in the above-mentioned document. Explain in your report (with photos) how you compensated your probes. (Make sure that you use your probe with appropriate attenuation factor).

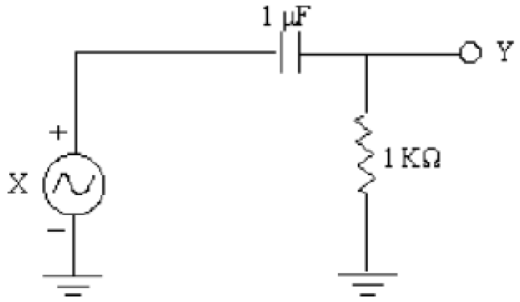
2. Using a signal generator, apply a **5 Vpp** (peak-to-peak) **sinusoidal signal** with frequency **1 kHz** (Note that this signal should not have a DC component). Use the oscilloscope to monitor this signal. First, use positive edge triggering and report (with photos) what you see on the screen. Then, apply negative edge triggering and report the result.

3. Apply a **1 Vpp triangular wave** with **2 kHz** frequency to the oscilloscope. Observe and report the effect of turning the trigger knob on the oscilloscope. Comment in your report on what the triggering concept is.

4. What is digital to analog converter (DAC)? What is an analog to digital converter (ADC)? What are they used for? Which one is used in oscilloscopes and how? Answer in your report. Apply a **1 Vpp square wave** with **5 kHz** frequency to the oscilloscope. Then try all the acquisition modes (sample, peak detect, average) and report (with photos) your observations.

5. Generate a **sinusoidal sign**al with **2 Vpp** amplitude and **1 kHz** frequency. Also apply a **DC offset of 1 V**. First, use DC coupling on the oscilloscope and report (with photos) what you see. Then use AC coupling and report the result. Comment on the difference.

6. Check how a breadboard works. Very briefly explain it in your report. Set up the following circuit on your breadboard. Do not forget to connect the grounds. It is common practice to use the long blue lines on your breadboard for ground and red lines for voltage sources as they connect to most other components. Notice that on some breadboards, these lines may be disconnected at the middle of the board.



Apply a **2 Vpp 1 kHz sinusoidal signal** (**with 0 DC offset**) as the X signal. Borrow a friend's probe and display both X and Y signals on the oscilloscope. Make sure you connect the grounds of both channels to the common ground; oscilloscopes measure voltage *differences*. Use channel 1 for X and channel 2 for Y. You should be using channel 1 as the trigger source. Learn how to measure time and voltage differences on an oscilloscope. Measure the delay between signals X and Y. Calculate the phase difference (note that a full period corresponds to a phase of 2π). Then, change the frequency to **100 kHz** and repeat. Report (with photos) the results. Try to comment on the difference between different frequencies.

(**Note:** If the signal generator is not terminated by an impedance of 50 Ohms but instead by high impedance, the output magnitude may be twice the desired value. Therefore, always check the values with oscilloscopes. While conducting above experiments and taking photos, make sure that it is the right thing that you are taking photos of.)