Laboratory 6 (1 day):
Flip-flops

Material covered and overview:
- This laboratory has ***one session*** allocated for completion.
- Stable and astable flip-flop circuits.
- ***Stable flip-flop*** circuits can be used as a 1-bit memory cell. They are the basis of SRAM storage devices. A stable flip-flop may also be called ***bi-stable flip-flop***.
- ***Astable flip-flop*** circuits are oscillators that produce a square-wave output. Astable flip-flops can be used to generate a blinking LED circuit or a circuit that generates an audio signal.

Exercise 1

In this exercise you will design and build your own flip-flop circuit. This may be a stable flip-flop or an astable flip-flop. The following points may be considered:

Stable flip-flop:
- Choose the collector current, for example, I_C = 10 mA, and determine the values of R_C and R_B accordingly.
- LEDs may be included in the circuit (collector branch) to indicate the logical state of the circuit. How about including an LED in each of the collector branches?
- How about including two push-button switches that allow you to set the flip-flop to its logical "0" and "1" state?

Astable flip-flop:
- Choose the collector current, for example, I_C = 25 mA, and determine the value of R_C. The base resistor R_B may be chosen to have a ten times higher resistance than the R_C.
- How about choosing an $R_B C$ time, for example 10 ms, and then determining the relevant R and C values?
- A speaker (or headphones) may be included when building an astable flip-flop working in the audio frequency range. Should the speaker (or headphones) be connected between collector and ground? You may want to include an emitter-follower amplifier for impedance matching.
- If no speaker (or headphones) are available, you may want to connect your circuit to an oscilloscope to see the square wave.