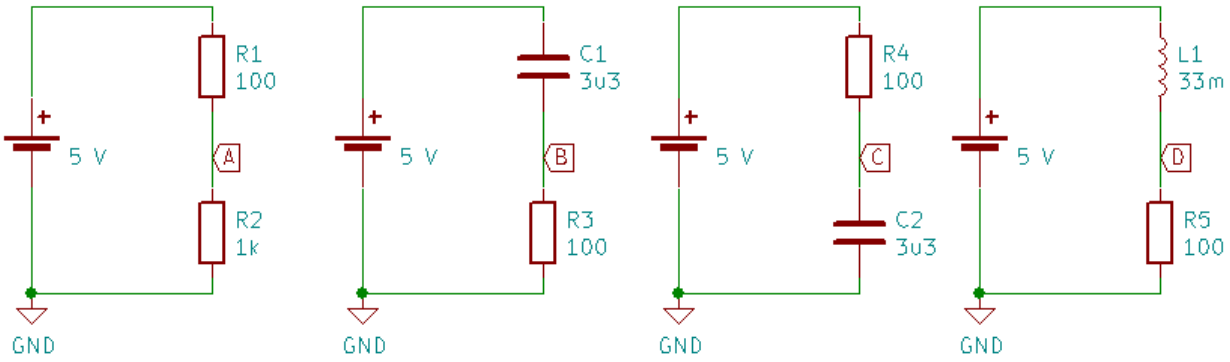
Problem 1 - Terms

Explain the following terms.

1) Impedance (Impedanssi). Describe the total impedance for two components in series and in parallel.
2) Frequency band (Taajuuskaista)
3) Low-, band- and high-pass filter (Ali-, kaistan- ja ylipäästösuodatin)
4) Equivalent circuit (Vastinpiiri)
5) Transfer function (Siirtofunktio)

Problem 2 - DC voltage in a circuit

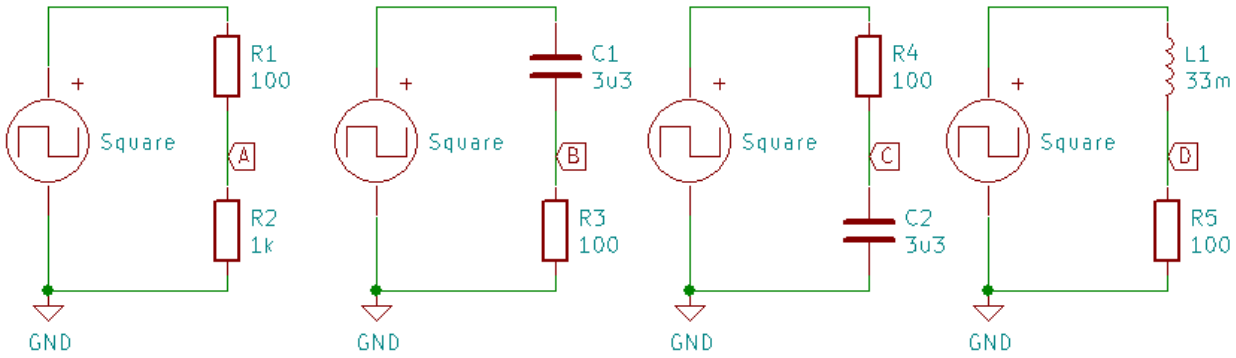
Calculate the voltages at A, B, C and D. Assume that the voltages have had time to stabilize. Note that the component parameters are in shortened form; the units are left out and the decimal points are replaced by the letter depicting the magnitude (e.g. for a capacitor: 3u3 = $3.3\mu F$).



Problem 3 - Step response of a circuit

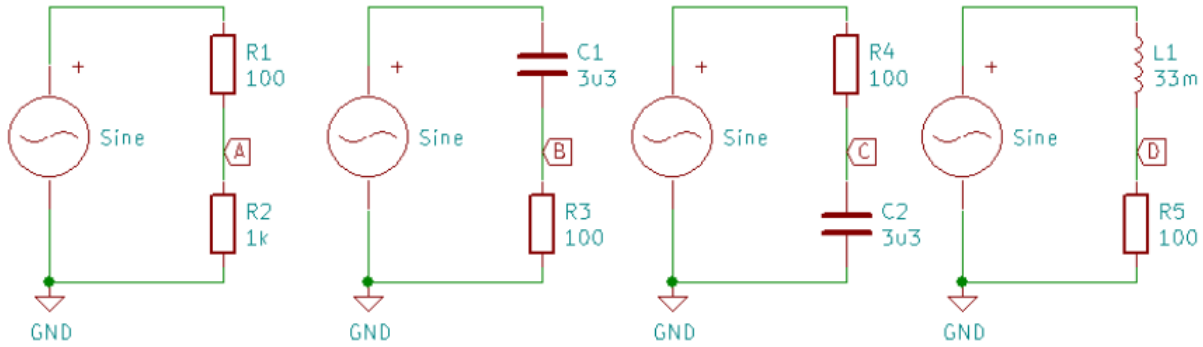
Calculate the step responses of the following circuits. In other words, calculate the voltages at A, B, C, D as a function of time after the rising and falling edges of a square wave. Assume that T, the period of the square wave, is much larger than τ, the time constant of the circuit.

Hint: A known solution for a certain differential equation: $C\frac{dx(t)}{dt} = -\frac{x(t)}{R} \rightarrow x(t) = Ae^{\frac{-t}{\tau}}$,
where $\tau = RC$ (capasitor), $\tau = \frac{L}{R}$ (inductor)



Problem 4 - AC simulation of circuits

Simulate the following circuits with LTspice. Find out the frequency response of the circuits by doing an AC analysis. What type of the filters are B, C, D? What are their cutoff frequencies?



These tasks are done at the exercise sessions using the following equipment.

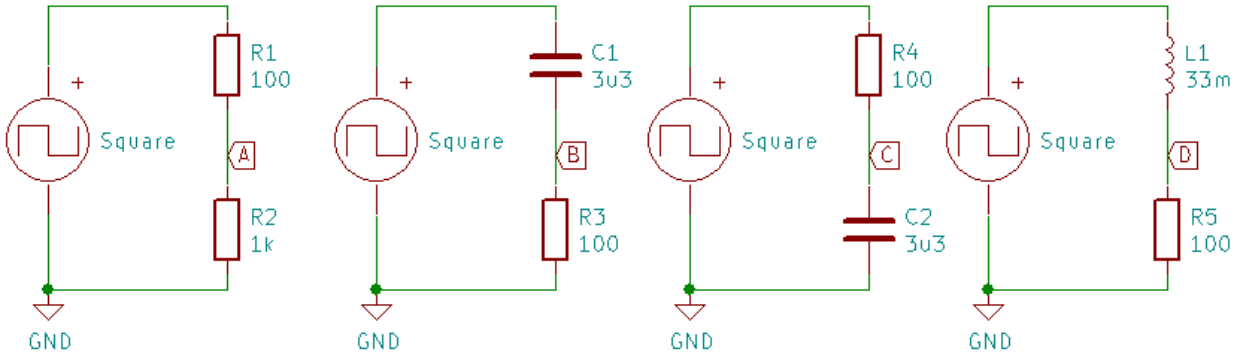
- Device: ADALM2000, a signal generator / oscilloscope combo device (link).
- Software: Scopy, which is used to control ADALM2000 (link).
  A guide to use each of the Scopy instruments is on bottom of the webpage.
- Various electronics components.

The course assistants will guide you.

Please read this tutorial before the exercise session: Transient responses of simple circuits

Hands on task 1.1

Measure the step response of the following circuits by using a square wave as the input signal.



Hands on task 1.2

Measure the frequency response of the following circuits. Does the resulting Bode plot match your simulated results?

