MANDATORY EXPERIMENTS

Experiment 1

The circuit shown in Fig. 1 is called Sallen active lowpass filter, where the triangle abstracts an op-amp amplification circuit with the gain K.

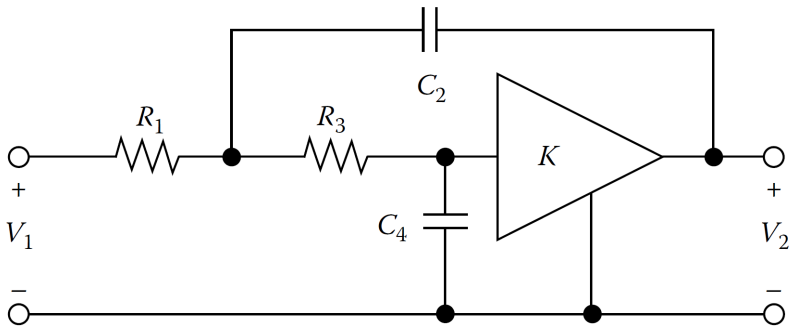

Figure 1: Sallen active lowpass filter.

(a) Calculate the frequency response of the active filter circuit.

(b) How can the amplifier part be implemented using op-amps?

(c) What are the advantages of the amplification part? Does it have any impact on the filtering response?

(d) What are the advantages and disadvantages of such an active filter

Experiment 2

The circuit shown in Fig. 2 is called Sallen active highpass filter, where the triangle abstracts an op-amp amplification circuit with the gain K.

Experiment 2 continued on next page...

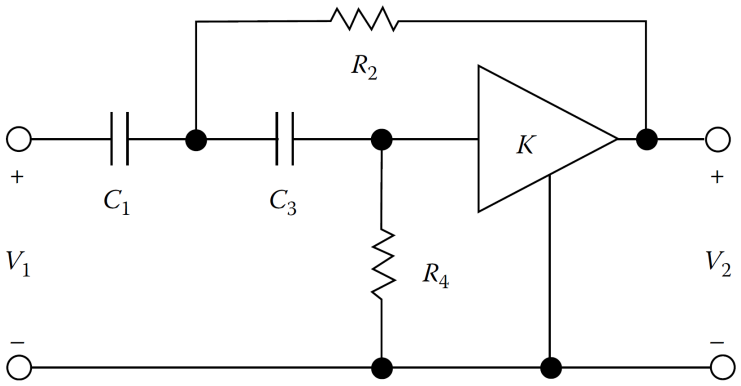

Figure 2: Sallen active highpass filter.

(a) Calculate the frequency response of the active filter circuit.

(b) Can you offer an active filter structure with bandpass frequency response?

Experiment 3

The series RC circuit of Fig. 2 is driven by a periodic pulse signal generated from a function generator. The voltage signal has the period T and duty cycle D K. Further, the capacitor and resistor have nominal values of $C = 1$ μF and $R = 1$ kΩ, respectively.

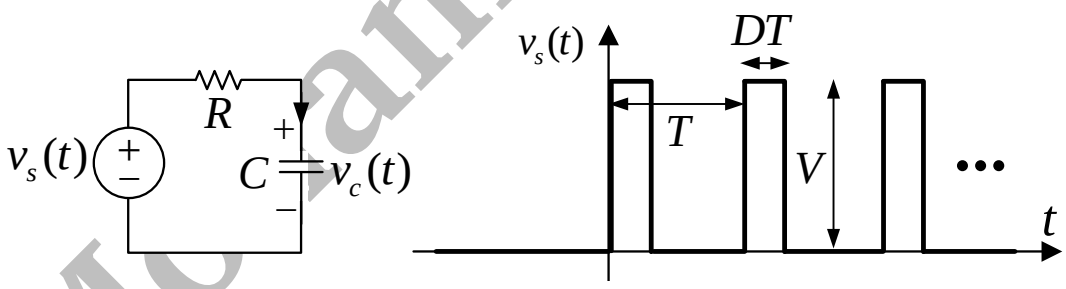

Figure 3: A series RC circuit.

(a) How can we practically measure the circuit time constant $\tau = RC = 1$ ms?

(b) The measured time constant is possibly different from the calculated theoretical value of $\tau = RC = 1$ *ms. Why?*

Experiment 4

Consider the passive LTI in-rest two-port network shown in Fig. 4.

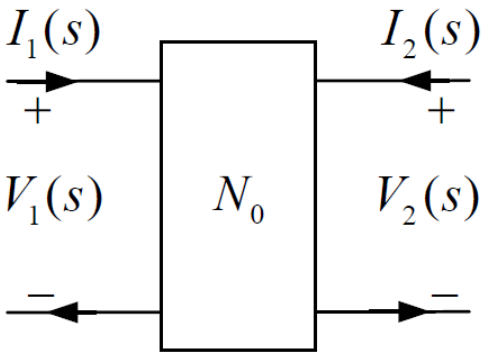

Figure 4: A passive LTI in-rest two-port.

(a) How can we measure the frequency response $H(j\omega) = \frac{V_2(j\omega)}{V_1(j\omega)}$ *of the two-port using an oscilloscope and a function generator?*

(b) Spectrum analyzer is a useful and versatile laboratory instrument. Explain how a spectrum analyzer works and how it can be used to experimentally measure the frequency response $H(j\omega) = \frac{V_2(j\omega)}{V_1(j\omega)}$ *of the two-port.*

BONUS EXPERIMENTS

Experiment 5

The circuit shown in Fig. 5 is called biquad active filter. The triangles denote amplifiers with the gains -1 **and** 2**. The amplifiers may be implemented using inverting and non-inverting op-amp circuits. The admittances** Y_1**,** Y_2**,** Y_3 **and** Y_4 **can be replaced by series or parallel RC circuits. A sample customized configuration is shown in Fig. 6. Depending on the configuration, the circuit provides various filtering responses.**

Experiment 5 continued on next page...

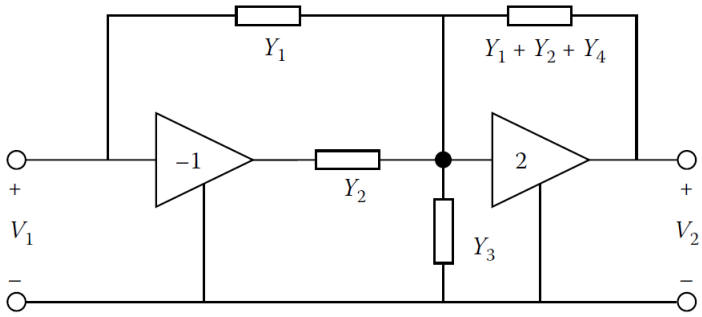

Figure 5: Biquad active filter.

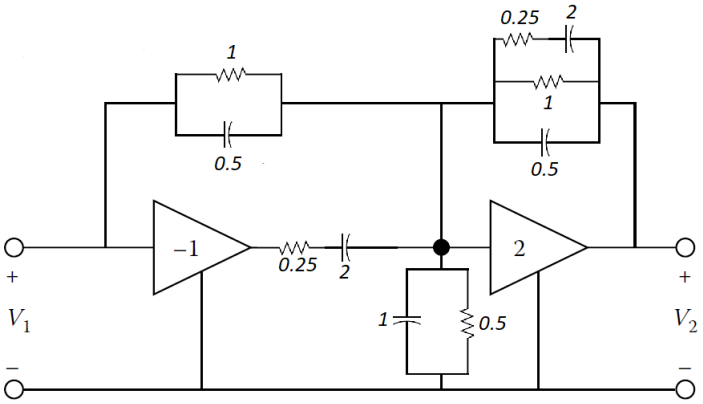

Figure 6: A sample customized realization of the biquad active filter.

(a) Simulate the circuit in PSpice and investigate the filtering response of the circuit for various configurations of Y_1, Y_2, Y_3 and Y_4. Especially, demonstrate how the biquad filter can have lowpass, highpass, bandpass, and bandstop frequency responses.

(b) What is an all-pass filter and how can it be implemented using a biquad?

Experiment 6

Return your answers by filling the LaTeXtemplate of the manual.