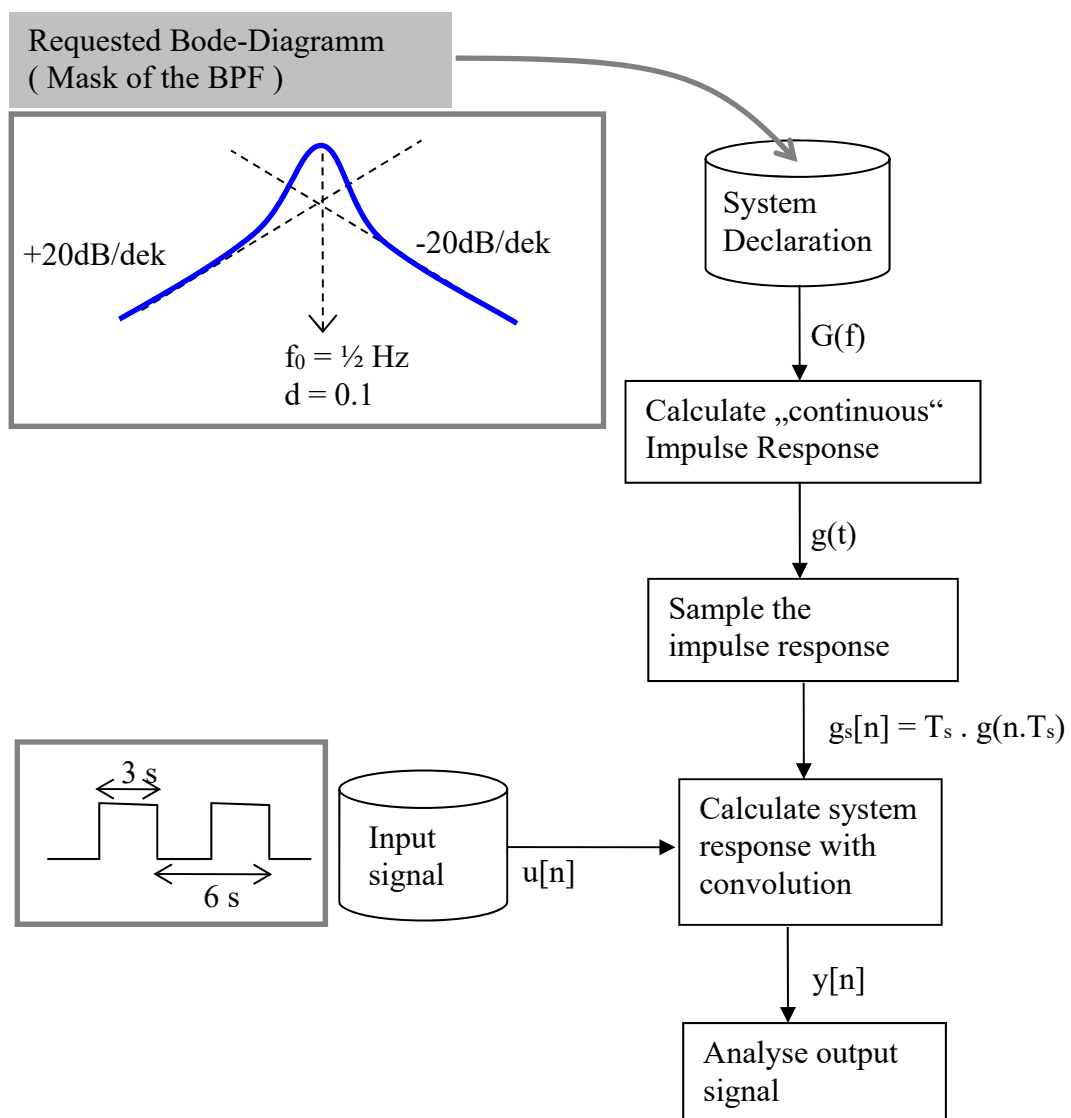


Laboratory 7: Filter Design and Application in numerical Simulations

In this exercise you will define a band pass filter in Matlab, and then use its impulse response to calculate the answer to an arbitrary input signal. Afterwards you will analyse the filtering effect both time and frequency domain.

Study the diagram below, which describes the single calculation steps of the Matlab script:



- a) Open the provided template Matlab script *SiSy_lab7a_template.m* . Complete the code in the places marked with the string "*WORK HERE!!!*", such as to carry out the calculation steps represented in the figure above.

Think about two different methods to analyse the output signal $y[n]$ and the effect of the filtering. For example:

- b) Analysis in the frequency domain: calculate with FFT the spectra of $u[n]$ and $y[n]$, and compare to the bode diagram of $G(f)$

Hint: pay attention that per default the bode command plots $G(\omega)$.

- c) Analysis in the time domain: which stationary response do you expect from this band-pass filter for the given input signal (period rectangular pulse)? Compare your expectation to the stationary part of the system output $y[n]$

OBS.: the stationary part comes after the transient part of the response. The transient part comes in the very beginning of your simulation, and fades away afterwards, it is the part of the response corresponding to the "switch-on" of the input signal.

- d) Explain the influence of the sampling for the accuracy of the calculation of $y[n]$. What can you do to avoid or minimize the aliasing effect here?
- e) Change now the input signal $u[n]$, such that you can calculate the step response of the system. Vary the value of the damping constant d (for example take $d = 0.05 ; 0.1 ; 0.2$) and explain the differences that you observe in the corresponding step responses.