Due: 06.05.2022

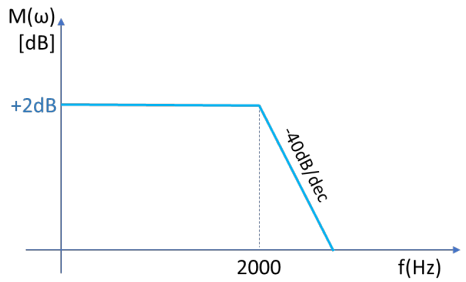
# Assignment #2

## Signals and Systems for Computer Engineering

(BLG354, CRN31560)

An audio record sample (music) is provided in the attached file (africa.wav). Sampling rate of this 16bit mono file is 44100Hz. Asymptotic frequency response (magnitude) graph of a $2^{nd}$ order low pass filter (LPF) is given in the below diagram

a) Write the transfer function of the below defined LPF in "s" domain.
b) Write the transfer function of the LPF in "z" domain for the sampling frequency $f_s$=44100Hz.
c) Write a pseudo code that performs the below given (asymptotical) LPF function by using the direct programming method.




d) Implement this LPF by using Python and write the output data into a file by appending LPF to its name (for example AfricaLPF.wav). Please provide the Python code that includes comments (LPF filter function will be performed depending on the pseudo code in part "c". Filtered audio file will also be given).
e) Provide a Python code that draws the actual Bode plot (Magnitude and phase) of the transfer function in "a". Logarithmic scale will be used in the frequency (Hz) axis. (Magnitude axis unit: dB, range: 10Hz…10kHz, Phase axis unit: degrees. There is no restriction in using the Python libraries for the Bode plot drawing code).

Suggested exercise: mix the original audio record with noise between 4kHz to 10kHz. You may use 80% original sound and the 20% the noise signal in the mixture. Test your LPF code on the noise added sound data. (Not compulsory)