4 Modelling of communication channels

For completing the tasks in this lab, you can use the Matlab files provided in channel_modelling.zip. Please use the Matlab files as a guide to complete the tasks.

Baseband channel modelling

1. A baseband channel can be modelled as an LTI low-pass filter with a cutoff frequency of f_c. The channel can be modelled as introducing attenuation, noise, ISI, and unknown propagation delay leading to synchronization issues. Your task is to write a Matlab function which can model a baseband channel.
   a) Assume in the following tasks that signals are sampled at a frequency f_s.
   b) Write a Matlab *channel* function that takes as input a sampled signal $x[n]$ and produces an output $y[n]$ which is a delayed version of $x[n]$; the delay (in number of samples) should be an input
   c) Modify your channel function to introduce additive white Gaussian noise into $y[n]$. The variance of additive white noise should be an input into the function.
   d) Modify your channel function to also low-pass filter the input $x[n]$; the low pass filter should have a gain g in the passband as input, and a passband cutoff frequency of f_c.
2. Plot the frequency and phase response of the channel that you have modelled for your choice of channel parameters.
3. Can you comment on how you would use the above approach to model an actual channel? That is, you would need to describe how this model is fit to an actual channel.

Passband channel modelling

1. A passband channel can be modelled as an LTI band-pass filter with a passband of $[f_{p,1}, f_{p,2}]$. The channel can be modelled as introducing attenuation, noise, ISI, and unknown propagation delay leading to synchronization issues. Your task is to write a Matlab function which can model a passband channel.
   a) Assume in the following tasks that signals are sampled at a frequency f_s.
   b) Write a Matlab *channel* function that takes as input a sampled signal $x[n]$ and produces an output $y[n]$ which is a delayed version of $x[n]$; the delay (in number of samples) should be an input
   c) Modify your channel function to introduce additive white Gaussian noise into $y[n]$. The variance of additive white noise should be an input into the function.
   d) Modify your channel function to also band-pass filter the input $x[n]$; the low pass filter should have a gain g in the passband as input, and a passband of $[f_{p,1}, f_{p,2}]$.
2. Plot the frequency and phase response of the channel that you have modelled for your choice of channel parameters.