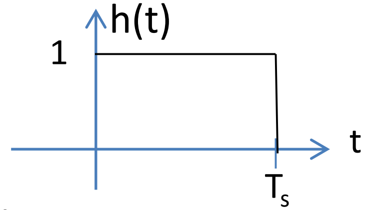
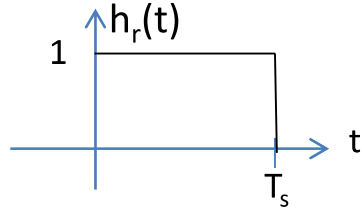
To transmit zero-mean, independant and equally symbols, we assume that we use this shaping filter impulse response:



And this receiver filter impulse response:



($R_s=1/T_s$: symbol rate
T_s: symbol duration)

QUESTION 1

The signal to noise ratio after sampling in the receiver is maximized:

Click on the bullet corresponding to the good answer

A TRUE

B FALSE

C Not enough elements to answer the question

BAD ANSWER

Click here to CHANGE YOUR ANSWER

GOOD ANSWER

Click [here] for the FOLLOWING QUESTION

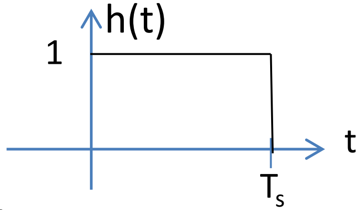
The matched filter, allowing to maximize the SNR after sampling at the receiver, is given by:

$$h_r(t) = \lambda h_e^*(t_0 - t)$$

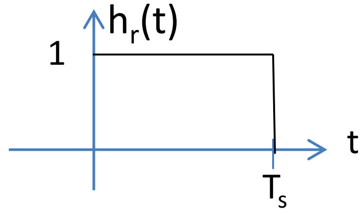
Where $h_e(t)=h(t)*h_c(t)$ **represents the received waveform (h(t) and $h_c(t)$ are the impulse responses of the shaping filter and of the propagation channel) and t_0 denotes the first time sampling instant (sampling at t_0+mT_s in the receiver).**

Here we do not know the propagation channel impulse response, $h_c(t)$, thus it is not possible to say if the receiver filter, $h_r(t)$, is a matched filter.

To transmit zero-mean, independant and equally symbols, we assume that we use this shaping filter impulse response:



And this receiver filter impulse response:



(R_s=1/T_s: symbol rate
T_s: symbol duration)

The transmission channel is assumed to be AWGN.

QUESTION 2

The signal to noise ratio, after sampling at optimal time sampling instants in the receiver, is maximized:

A TRUE

B FALSE

C Not enough elements to answer the question

BAD ANSWER

Click here to CHANGE YOUR ANSWER

GOOD ANSWER

Click here for the FOLLOWING QUESTION

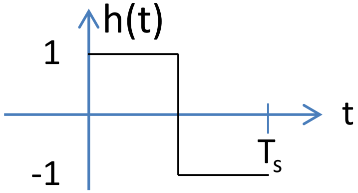
The matched filter, allowing to maximize the SNR after sampling at the receiver, is given by :

$$h_r(t) = \lambda h_e^*(t_0 - t)$$

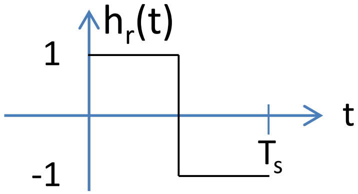
where $h_e(t)=h(t)*h_c(t)$ (receiver input waveform), sampling at t_0+mT_s.

Here the channel is assumed to be AWGN, so its impulse response is a dirac : $h_c(t)=\delta(t)$ (no filtering in the channel, the channel just adds a white and Gaussian noise to the transmitted signal), thus $h_r(t)$ must be matched to h(t), which is the case: the matched filter corresponding to a filter whose impulse response is rectangular of length T_s is a filter with a rectangular impulse response of length T_s for t_0=Ts (=> optimal sampling instants)

To transmit zero-mean, independant and equally symbols, we assume that we use this shaping filter impulse response:



And this receiver filter impulse response:



($R_s=1/T_s$: symbol rate
T_s: symbol duration)

The transmission channel is assumed to be AWGN.

QUESTION 3

The signal to noise ratio, after samping at optimal time sampling instants , is maximized:

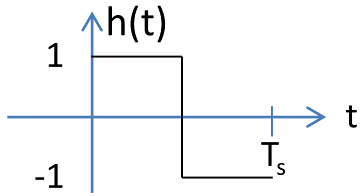
A TRUE

B FALSE

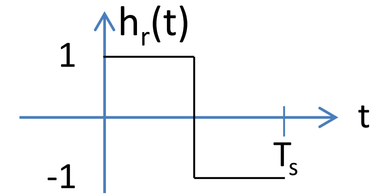
C Not enough elements to answer the question

BAD ANSWER

Click here to CHANGE YOUR ANSWER



AWGN channel



GOOD ANSWER

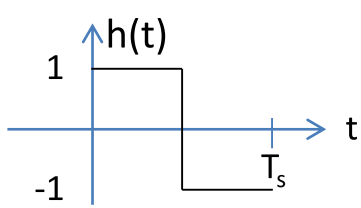
Click [here](#) for the FOLLOWING QUESTION

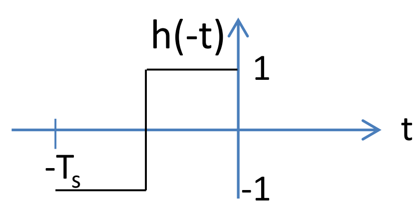
The matched filter, allowing to maximize the SNR after sampling at the receiver, is given by :

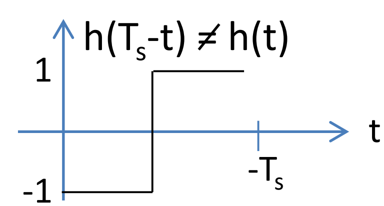
$$h_r(t) = \lambda h_e^*(t_0 - t)$$

where $h_e(t)=h(t)*h_c(t)$ (receiver input waveform), sampling at t_0+mT_s.

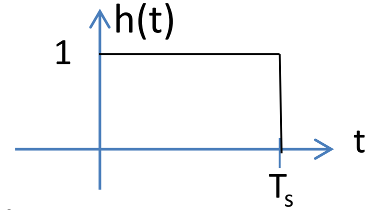
Here the channel is assumed to be AWGN, so its impulse response is a dirac : $h_c(t)=\delta(t)$ (no filtering in the channel, the channel just adds a white and Gaussian noise to the transmitted signal), thus $h_r(t)$ must be matched to $h(t)$, which is not the case here:



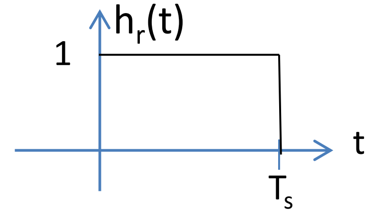




To transmit zero-mean, independant and equally symbols, we assume that we use this shaping filter impulse response:



And this receiver filter impulse response:



($R_s=1/T_s$: symbol rate
T_s: symbol duration)

The transmission channel is assumed to be AWGN.

QUESTION 4

Considering optimal sampling time instants and optimal decision thresholds at the receiver, the transmission symbol error rate (SER) is minimized:

A TRUE

B FALSE

C Not enough elements to answer the question

BAD ANSWER

Click here to CHANGE YOUR ANSWER

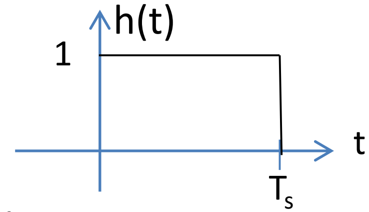
GOOD ANSWER

Click here for the FOLLOWING QUESTION

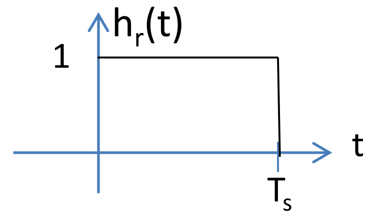
To minimize the SER, we need to respect the Nyquist criterion, which is the case here if we sample at the optimal instants T_s+mT_s, we need to use a matched filter at the receiver, which is the case, and we need to choose the optimal thresholds to make the decisions, which is also the case here.

The SER will then be minimized.

To transmit zero-mean, independant and equally symbols, we assume that we use this shaping filter impulse response:



And this receiver filter impulse response:



($R_s=1/T_s$: symbol rate
T_s: symbol duration)

The transmission channel is assumed to be AWGN.

QUESTION 5

Considering optimal sampling time instants and optimal decision thresholds at the receiver, the transmission bit error rate (BER) is minimized:

A TRUE

B FALSE

C Not enough elements to answer the question

BAD ANSWER

Click here to CHANGE YOUR ANSWER

GOOD ANSWER

Click here for the FOLLOWING QUESTION

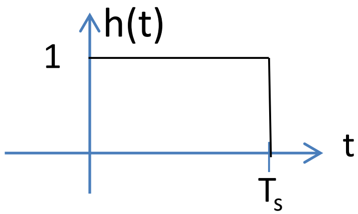
To minimize the SER, we need to respect the Nyquist criterion, which is the case here if we sample at the optimal instants T_s+mT_s, we need to use a matched filter at the receiver, which is the case, and we need to choose the optimal thresholds to make the decisions, which is also the case here.
The SER will then be minimized.

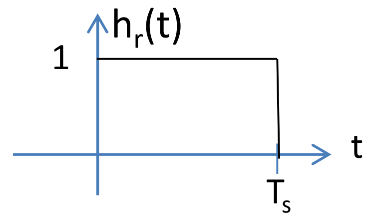
BUT we do not have any information about the mapping, so it is not possible to say wether the BER will be minimized or not.

Let's consider a 4-PAM modulation with the following mapping:

Bits	Symbols
00	-3V
01	-V
10	+V
11	+3V

We give the shaping filter impulse response, h(t), and the receiver filter impulse response, $h_r(t)$:





($R_s=1/T_s$: symbol rate
T_s: symbol duration)

The transmission channel is assumed to be AWGN.

QUESTION 6

Considering optimal sampling time instants and optimal decision thresholds at the receiver, the bit error rate (BER) is minimized:

A TRUE

B FALSE

C Not enough elements to answer the question

BAD ANSWER

Click here to CHANGE YOUR ANSWER

GOOD ANSWER

Click here for the FOLLOWING QUESTION

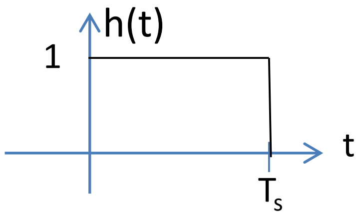
To minimize the SER, we need to respect the Nyquist criterion, which is the case here if we sample at the optimal instants T_s+mT_s, we need to use a matched filter at the receiver, which is the case, and we need to choose the optimal thresholds to make the decisions, which is also the case here. The SER will then be minimized.

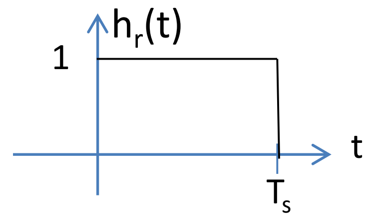
BUT the mapping is not a Gray Mapping, then the BER won't be the minimum one.

Let's consider a 4-PAM modulation with the following mapping suivant:

Bits	Symboles
00	-3V
01	-V
11	+V
10	+3V

We give the shaping filter impulse response, $h(t)$, and the receiver filter impulse response, $h_r(t)$:





($R_s=1/T_s$: symbol rate
T_s: symbol duration)

The transmission channel is assumed to be AWGN.

QUESTION 7

Considering optimal sampling time instants and an optimal decision threshold at the receiver, the bit error rate (BER) is minimized:

A TRUE

B FALSE

C Not enough elements to answer the question

BAD ANSWER

Click here to CHANGE YOUR ANSWER

GOOD ANSWER

Click here for the FOLLOWING QUESTION

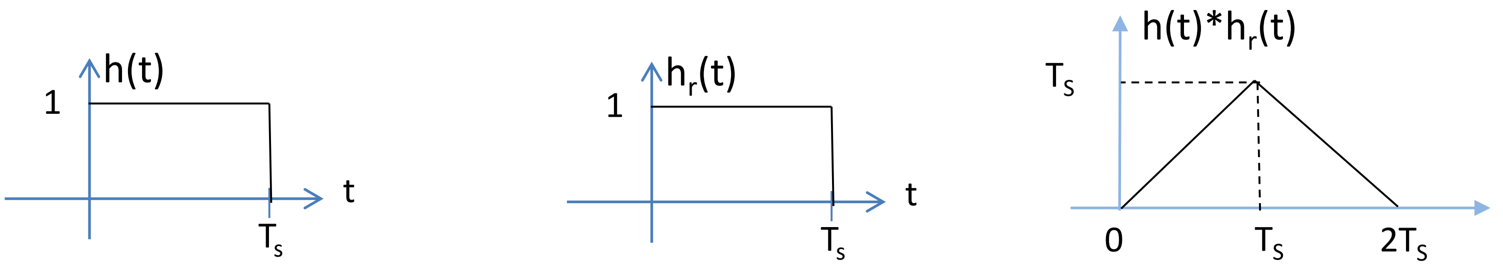
To minimize the SER, we need to respect the Nyquist criterion, which is the case here if we sample at the optimal instants T_s+mT_s, we need to use a matched filter at the receiver, which is the case, and we need to choose the optimal thresholds to make the decisions, which is also the case here. The SER will then be minimized.

Used mapping is a Gray mapping, so the BER will be the minimum one and equal to the SER/2, neglecting the probabilities to make errors between two symbols which are not at the minimum distance.

Let's consider a 2-PAM modulation with the following mapping:

Bits	Symboles
0	0
1	V

We give the shaping filter impulse response, $h(t)$, the receiver filter impulse response, $h_r(t)$ and their convolution product:



The transmission channel is assumed to be AWGN.

($R_s=1/T_s$: symbol rate
T_s: symbol duration)

QUESTION 8

If we sample at T_s+mT_s in the receiver, the minimum distance between the samples without noise will be:

A V

B VT_s

C 2V

BAD ANSWER

Click here to CHANGE YOUR ANSWER

GOOD ANSWER

Click here for the FOLLOWING QUESTION

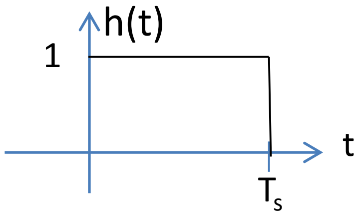
Used filters in the transmission channel allow to respect the Nyquist criterion. When we sample at T_s+mT_s we obtain after sampling $a_m g(t_0)+w_m=a_m T_s+w_m$, where a_m represents the symbol transmitted at time instant mT_s and w_m is a sample of filtered noise.

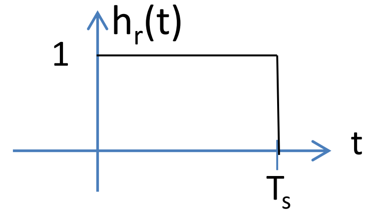
Transmitted symbols being 0 or V, without noise we obtain 0 or VT_s after sampling, so $D_{min}=VT_s$

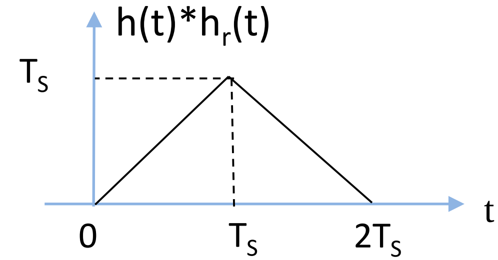
Let’s consider a 2-PAM modulation with the following mapping suivant:

Bits	Symboles
0	0
1	V

We give the shaping filter impulse response, $h(t)$, the receiver filter impulse response, $h_r(t)$ and their convolution product:







The transmission channel is assumed to be AWGN.

($R_s=1/T_s$: symbol rate
T_s: symbol duration)

QUESTION 9

If we sample at T_s+mT_s in the receiver, the optimal threshold to take the decisions will be:

- A V/2
- B 0
- C $VT_s/2$

BAD ANSWER

Click here to CHANGE YOUR ANSWER

GOOD ANSWER

Click here for the FOLLOWING QUESTION

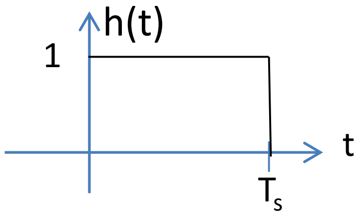
Used filters in the transmission channel allow to respect the Nyquist criterion. When we sample at T_s+mT_s we obtain after sampling $a_m g(t_0)+w_m=a_m T_s+w_m$, where a_m represents the symbol transmitted at time instant mT_s and w_m is a sample of filtered noise.

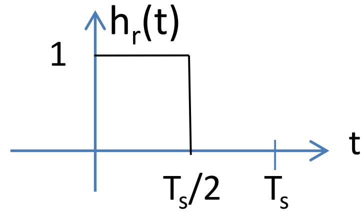
Transmitted symbols being 0 or V, without noise we obtain 0 or VT_s after sampling, so the optimal threshold to take the decisions will be $VT_s/2$.

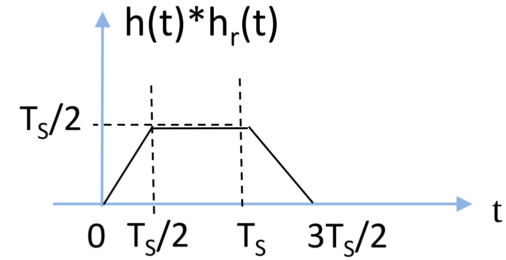
Let's consider a 2-PAM modulation with the following mapping suivant:

Bits	Symboles
0	-1
1	+1

We give the shaping filter impulse response, $h(t)$, the receiver filter impulse response, $h_r(t)$ and their convolution product:







The transmission channel is assumed to be AWGN.

($R_s=1/T_s$: symbol rate
T_s: symbol duration)

QUESTION 10

If we sample at T_s+mT_s in the receiver and use a 0 threshold detector to take the decisions, then the BER will be:

A $= Q\left(\sqrt{\frac{2E_b}{N_0}}\right)$

B $> Q\left(\sqrt{\frac{2E_b}{N_0}}\right)$

C $< Q\left(\sqrt{\frac{2E_b}{N_0}}\right)$

BAD ANSWER

Click here to CHANGE YOUR ANSWER

GOOD ANSWER

Click here for the FOLLOWING QUESTION

$$BER = Q\left(\sqrt{\frac{2E_b}{N_0}}\right)$$

Is the minimum BER we can obtain for the transmission of binary zero mean independent and equally likely symbols.

Here the receiver filter is not matched to the shaping filter (no filter for the channel). So the BER will be higher.

QUESTION 11

The power efficiency for a digital communication measures:

A The needed bandwidth to transmit a given bit rate

B The needed SNR per bit at the receiver input to obtain a given BER

C The needed power to obtain a given power spectral density

BAD ANSWER

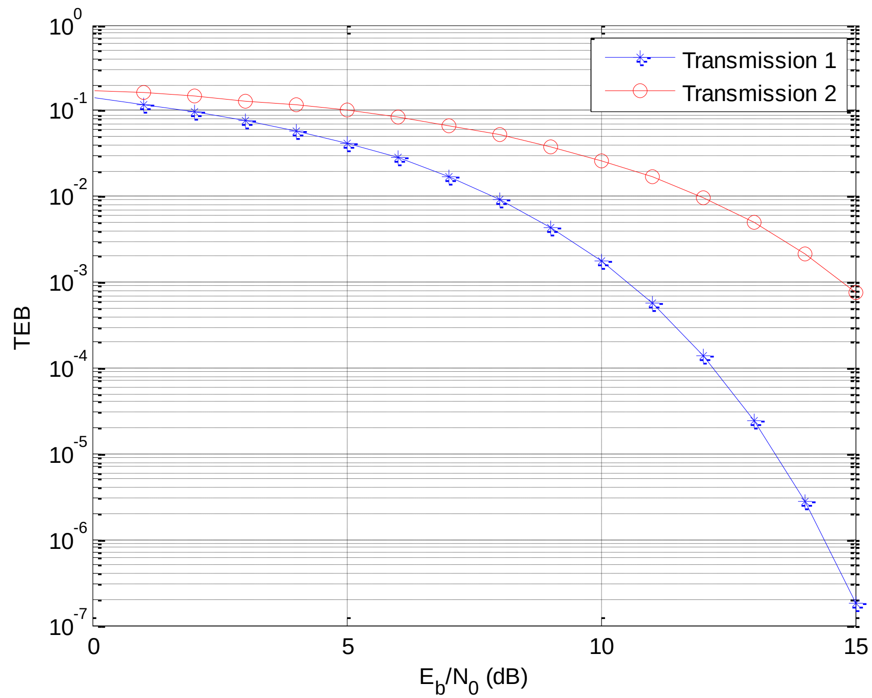
Click here to CHANGE YOUR ANSWER

GOOD ANSWER

Click here for the FOLLOWING QUESTION

The needed bandwidth to transmit a given bit rate is the spectral efficiency of the transmission.
The needed power to obtain a given power spectral density means nothing.

We give below the BER as a function of E_b/N_0 for two transmission channels:



QUESTION 12

Transmission 1 has:

A — A higher power efficiency than transmission 2

B — A lower power efficiency than transmission 2

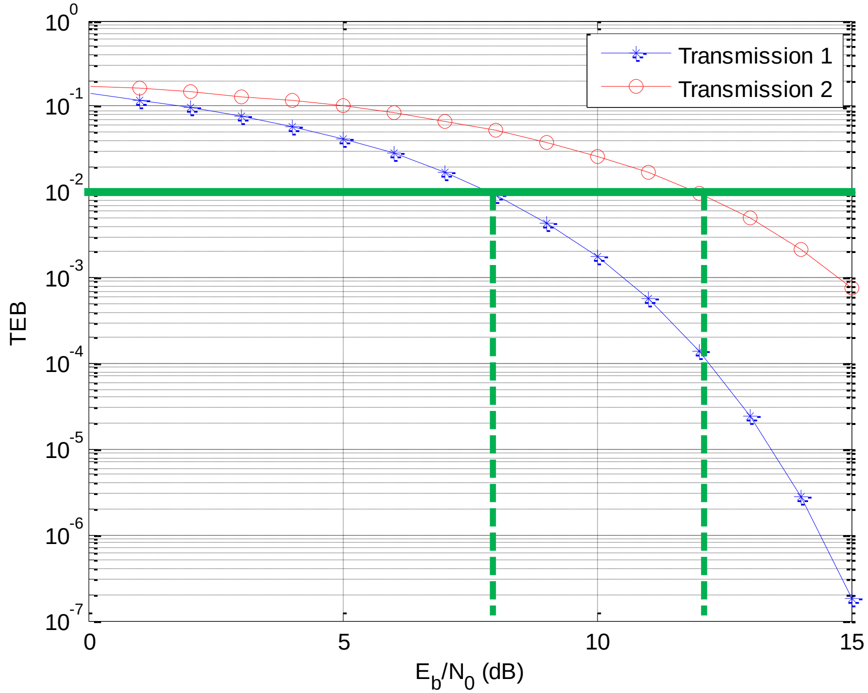
C — Not enough elements to answer the question

BAD ANSWER

Click here to CHANGE YOUR ANSWER

GOOD ANSWER

Click here for the FOLLOWING QUESTION



For a given BER to be reached, transmission channel 1 always need a lower E_b/N_0 compared to transmission 2 (an example is plotted in green on the figure for a given BER of 10^{-2}).

E_b/N_0 represents the signal to noise ratio per bit at the receiver input. To ensure a given BER, the transmission needing the lowest E_b/N_0 (meaning, for a given noise, the lowest power at the receiver input, so the lowest transmitted power) will be the most power efficient, because it will need the lowest transmitted power to obtain the wanted BER (so the wanted quality for the transmission).

Here transmission 1 is more power efficient than transmission 2.

THE QUIZ IS FINISHED