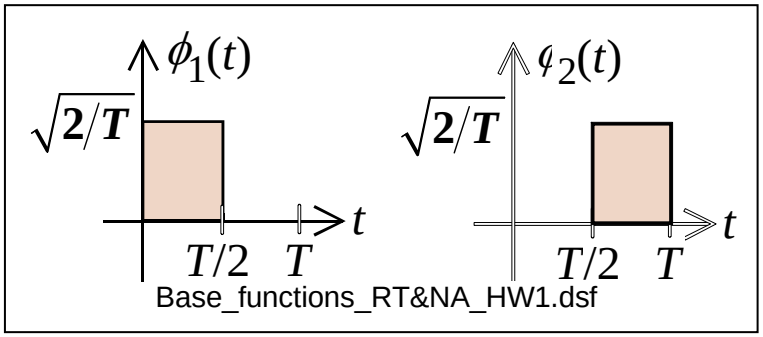
S-72.3230 Radio transmission and network access
Unchecked answers to the home works, might contain errors

Homework 1. Submit your solution at latest on 15th December, 2005

a) One example of choice of base functions

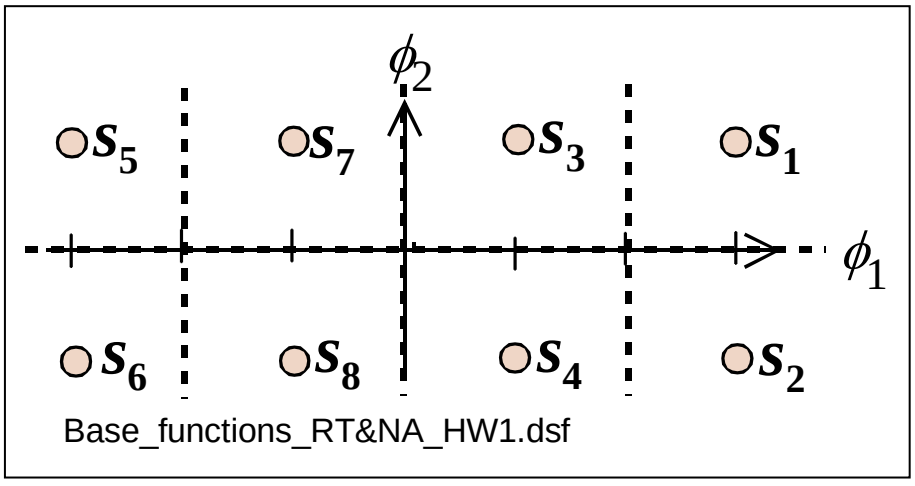


Signal vectors:

$$S_1 = a\sqrt{\frac{T}{2}}\begin{bmatrix}3\\1\end{bmatrix} \quad S_2 = a\sqrt{\frac{T}{2}}\begin{bmatrix}3\\-1\end{bmatrix} \quad S_3 = a\sqrt{\frac{T}{2}}\begin{bmatrix}1\\1\end{bmatrix} \quad S_4 = a\sqrt{\frac{T}{2}}\begin{bmatrix}1\\-1\end{bmatrix}$$

$$S_5 = a\sqrt{\frac{T}{2}}\begin{bmatrix}-3\\1\end{bmatrix} \quad S_6 = a\sqrt{\frac{T}{2}}\begin{bmatrix}-3\\-1\end{bmatrix} \quad S_7 = a\sqrt{\frac{T}{2}}\begin{bmatrix}-1\\1\end{bmatrix} \quad S_8 = a\sqrt{\frac{T}{2}}\begin{bmatrix}-1\\-1\end{bmatrix}$$

Constellation and decision areas:

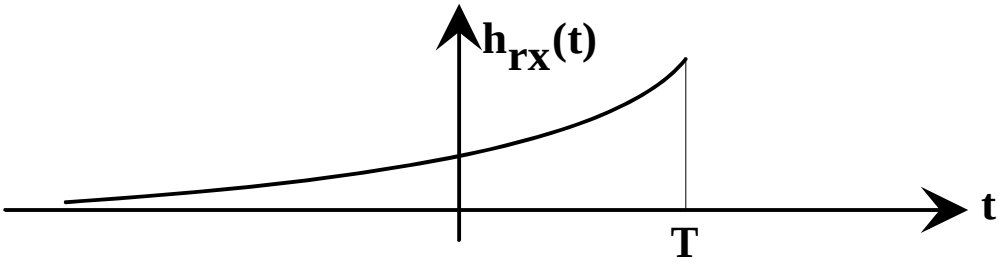


b) $$P_s = \frac{5}{2}\mathrm{Q}\left(\sqrt{\frac{2\bar{E}_b}{N_o}}\right) - \frac{3}{2}\mathrm{Q}^2\left(\sqrt{\frac{2\bar{E}_b}{N_o}}\right)$$

c) 8.33 dB

Homework 2

a) $h_{rx}(t) = c \cdot h_{tx}(T-t) = \frac{1}{\tau}\exp\left(-\left(T-t\right)/\tau\right) \cdot \mathrm{u}(T-t)$



b) $s = \sqrt{\frac{E}{\tau}}\left(1-\exp\left(T/\tau\right)\right) \qquad \sigma_n^2 = \frac{N_o}{2\tau}\left(1-\exp\left(-2T/\tau\right)\right)$

c) $T = 2.86\tau$

Homework 3

a) 9 bits and 28.43 bits

b) 11.64 bits

Homework 4

a) 2.96%

b) 1.00 bit/s/Hz

c) ΔSNR = 4.75 dB

Homework 5

a) 2 times.

b) 0 dB

c) Comparing d/σ for the two constellations: 6.99 dB.

Homework 6

The bit error probability of differentially decoded BPSK in the AWGN-channel is $BEP = 0.5\exp\left(-E/N_o\right) = 0.5\exp\left(-\gamma\right)$.

a) $\boldsymbol{P_b = \frac{1}{2\left(1+\gamma_m\right)}}$

b) 10.98 dB and 27.68 dB

Homework 7

a) 102 users .

b) From 1.55 dB to 2.84 dB

Homework 8

a) 22.90 dB
b) $\Delta SNR = 6.93$ dB

Homework 9.

The task is not fully clearly defined. Assuming that the user bit rate can be reduced with 10%, the power level reduction is 3.25 dB

Homework 10

a) $P_{packet} = 0.1$
b) 10 and 1053 bits