Fig. 1

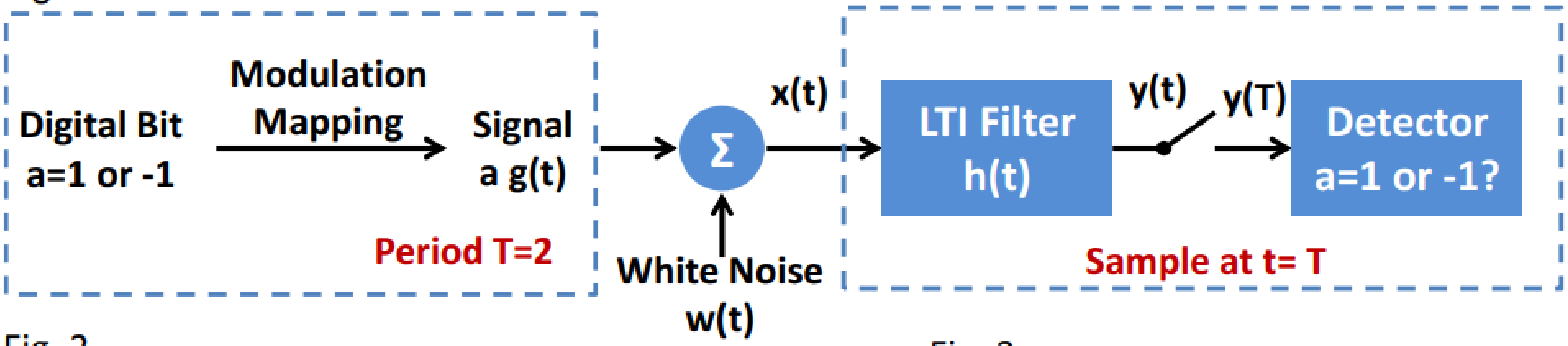


Fig. 2

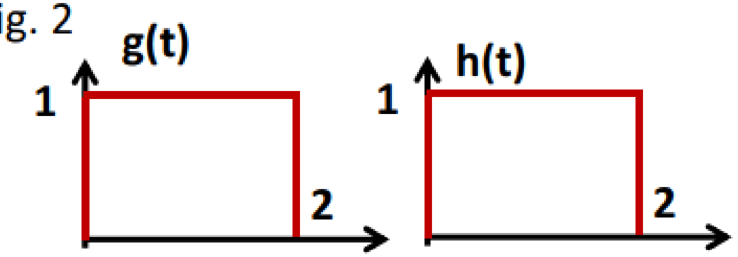
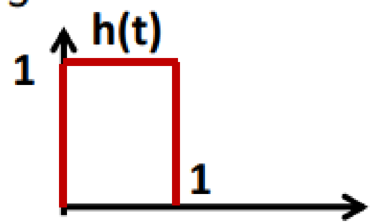


Fig. 3



- D4.1

Consider the baseband transceiver in Fig. 1, where g(t) and h(t) are given by Fig. 2,

(a) Please sketch the PSD of noise in y(t).

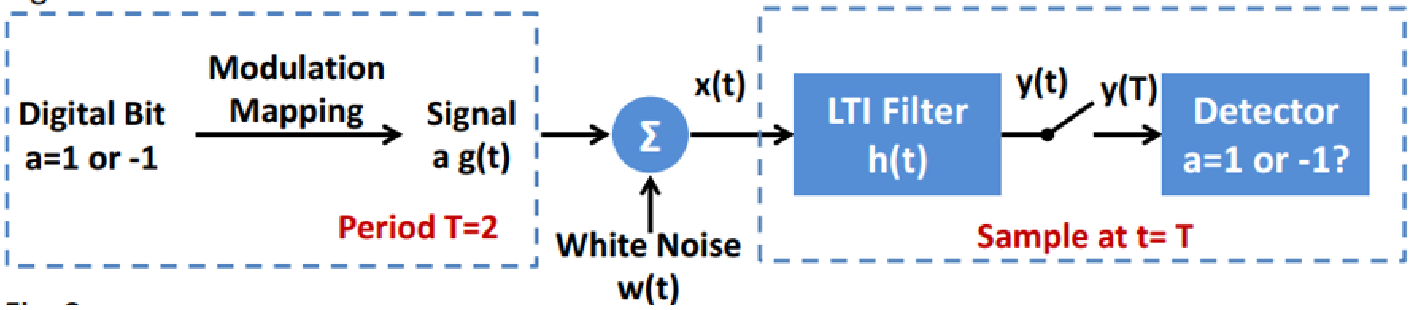
(b) What is the signal power in y(T)? What is the noise power in y(T)? What is the SNR of y(T)?

(c) If h(t) is given by Fig. 3, what is your answer of question (b)?

(d) Compare the SNR of question (b) and (c), which impulse response h(t) is better for receiver?

Solution：

Fig. 1

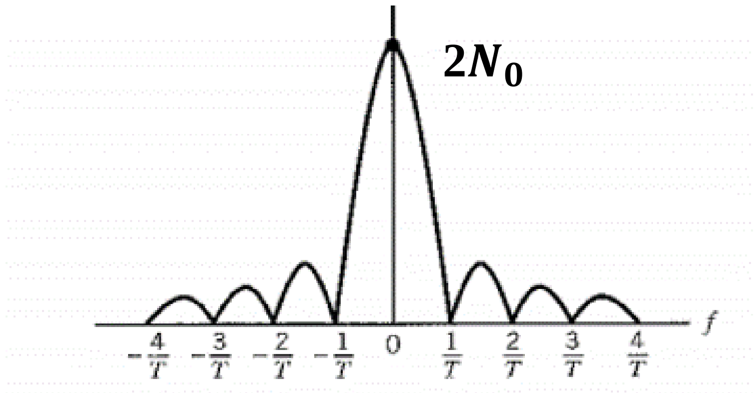


$x(t) = ag(t) + w(t)$

signal noise

$y(t) = x(t)\otimes h(t) = (ag(t) + w(t))\otimes h(t) = \boxed{ag(t)\otimes h(t)} + \boxed{w(t)\otimes h(t)}$

a) PSD of noise in y(t) = $\frac{N_0|H(f)|^2}{2}$

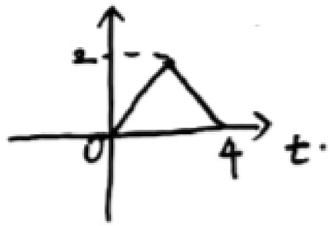


T = 2

b) $y(T) = ag(t)\otimes h(t)|_{t=T} + w(t)\otimes h(t)\,|_{t=T} = g_0(T) + n(T)$

Signal power $= |ag(t)\otimes h(t)|_{t=T}|^2 = |g_0(T)|^2$

$g(t)\otimes h(t)$ $\longrightarrow$



Signal power = $2^2 = 4$

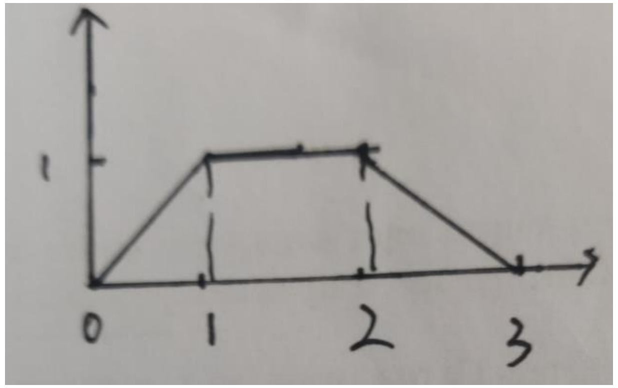
Noise power = $E\left(n^2(T)\right) = \frac{N_0}{2}\int_{-\infty}^{\infty}|H(f)|^2 df = \frac{N_0}{2}\int_0^2 |h(t)|^2 dt = N_0$

SNR = $\frac{4}{N_0}$

Solution:

c) $y(T) = \ ag(t) \otimes h(t)|_{t=T} + w(t) \otimes h(t)\ |_{t=T} = g_0(T) + n(T)$

$g(t) \otimes h(t)$



Signal power $= |ag(t) \otimes h(t)|_{t=T}|^2 = |g_0(T)|^2$

Signal power $= 1^2 = 1$

Noise power $= E\left(n^2(T)\right) = \frac{N_0}{2} \int_{-\infty}^{\infty} |H(f)|^2 df = \frac{N_0}{2} \int_0^1 |h(t)|^2 dt = \frac{N_0}{2}$

SNR $= \frac{1}{\frac{N_0}{2}} = \frac{2}{N_0}$

d)

$SNR_b > \ SNR_c$

The impulse response h(t) in b is better