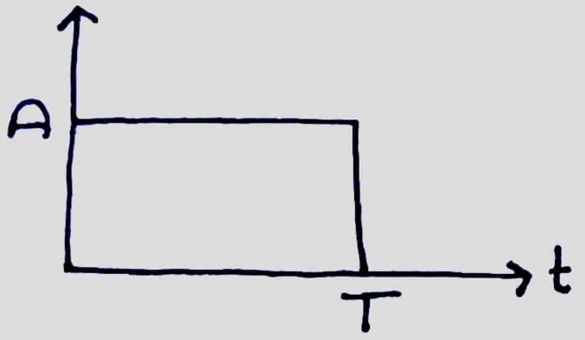
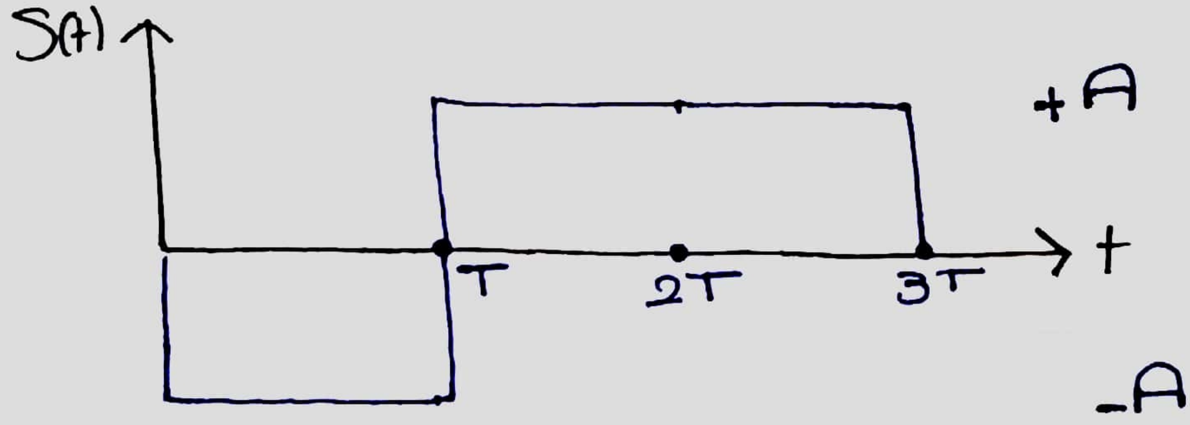
Assignment 2

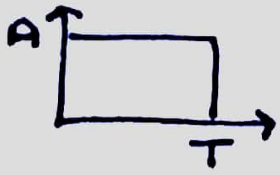
1.

$g(t) =$ 

• Polar NRZ Signaling

a) 

$b_0 = '0'$ $b_1 = '1'$ $b_2 = '1'$

b) $h(t) = g(T-t) =$ 

$= g(t)$ } shift then reflect

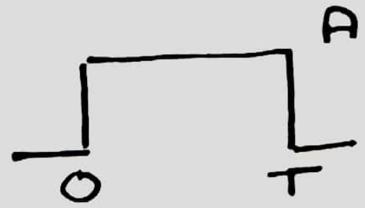
$g_0(t) = h(t) * S(t)$

• We let K=1 as it doesn't affect the decision

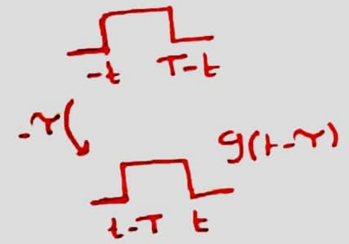
$= h(t) * (-g(t) + g(t-T) + g(t-2T))$

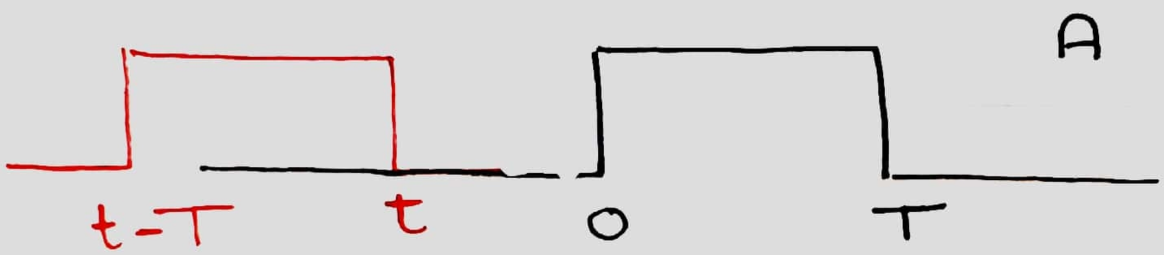
Can thus start with $g(t) * g(t)$ and then use linearity of convolution to evaluate $g_0(t)$

g

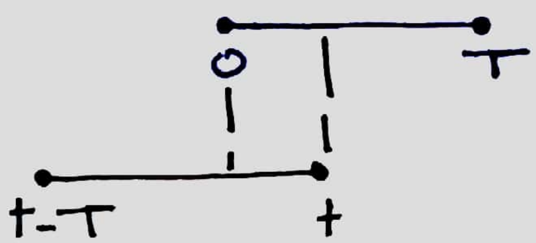
$f(t) = g(t) * g(t)$, $g(t) =$ 

$= \int_{-\infty}^{\infty} g(\tau)\, g(t-\tau)\, d\tau$





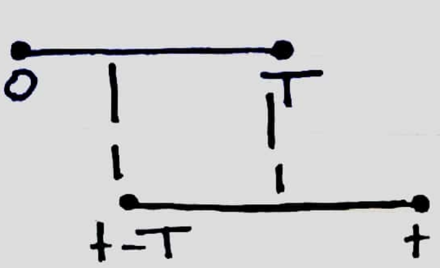
Case #1)



* Partial overlap in
$0 \leq t < T$

$f(t) = \int_{0}^{t} A.A\, d\tau = A^2 t$

Case #2)



* Partial overlap out
$0 \leq t-T < T$
$(T \leq t < 2T)$

$f(t) = A^2(T-(t-T))$
(overlap area = S)

Thus,

$$p(t) = g(t) * g(t) = \begin{cases} A^2 t & 0 \leq t < T \\ A^2(2T-t) & T < t \leq 2T \\ 0 & \text{o.w.} \end{cases}$$

$$g_0(t) = h(t) * (-g(t) + g(t-T) + g(t-2T))$$

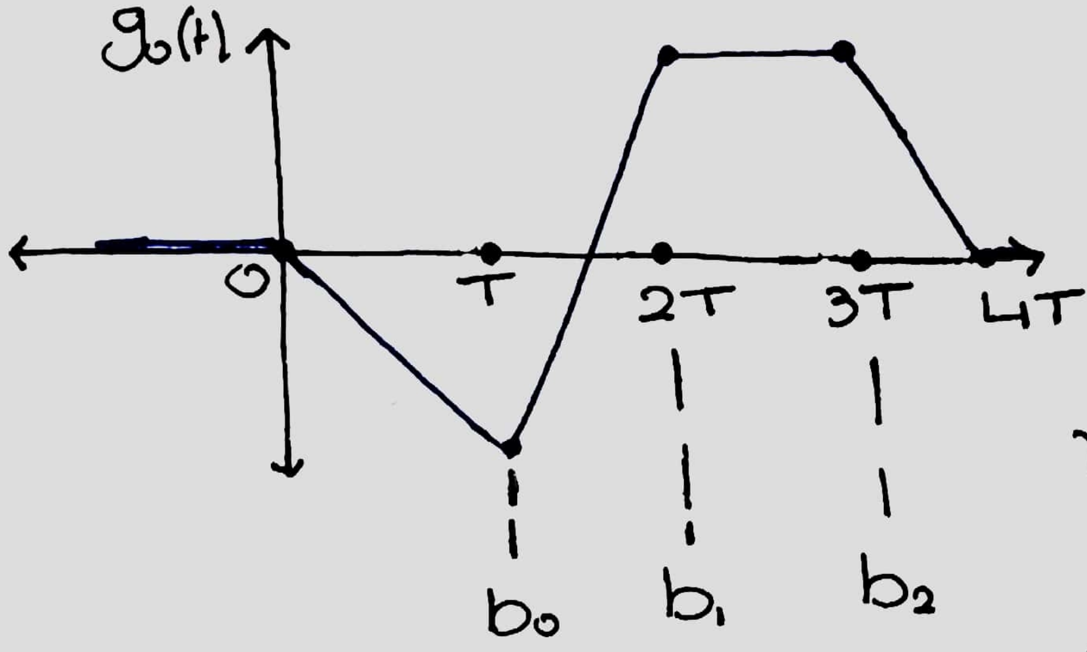
$$= -p(t) + p(t-T) + p(t-2T)$$

$$g_0(t) = \begin{cases} -A^2 t & 0 \leq t < T \\ -A^2(2T-t) + A^2(t-T) & T < t \leq 2T \\ 0 + A^2(2T-(t-T)) + A^2(t-2T) & 2T \leq t < 3T \\ A^2(2T-(t-2T)) & 3T \leq t < 4T \end{cases}$$

and 0 otherwise.

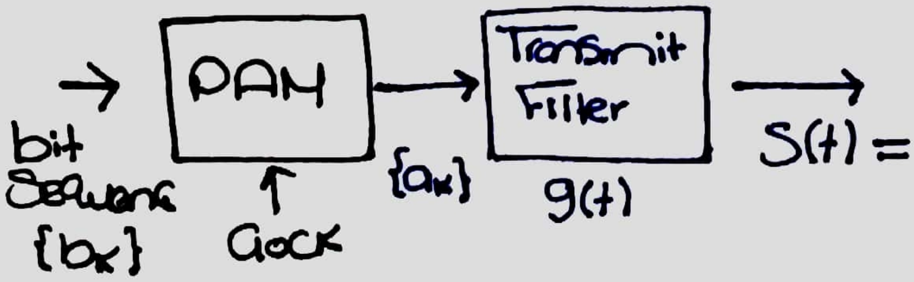
$$g_0(t) = \begin{cases} -A^2 t & 0 \leq t < T \\ A^2(2t-3T) & T < t \leq 2T \\ A^2 T & 2T \leq t < 3T \\ A^2(4T-t) & 3T \leq t < 4T \end{cases}$$

t	0	T	$2T$	$3T$	$4T$
$g_0(t)$	0	$-A^2T$	A^2T	A^2T	0



c) Sampling instances

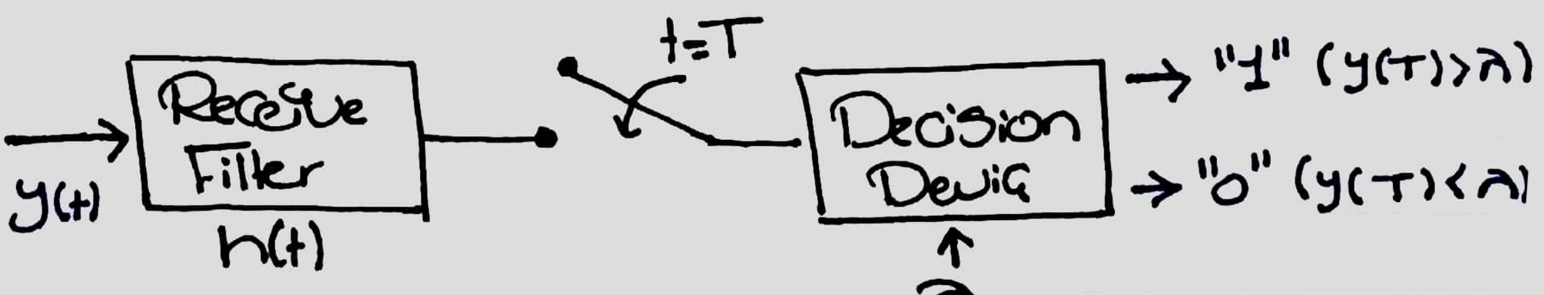
d) Transmitter



#Channel

$$s(t) = \sum_k a_k\, g(t-kT)$$

e) Receiver



- $y(t) = s(t) + w(t)$ ← AWGN by Channel