CAIRO UNIVERSITY
COMPUTER ENGINEERING

Assignment #1

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Course: *Digital Communications* – Professor: *Dr. Mai Badawi*
Due date: *April 10, 2020*

Part II

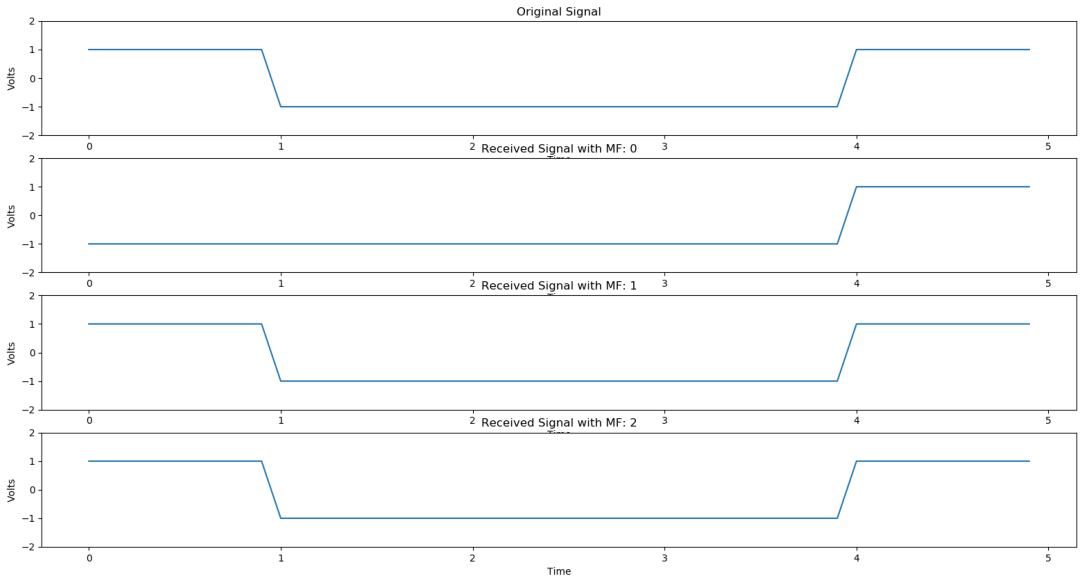
Requirement 2

Plot the output of the receive filter for the three mentioned cases.

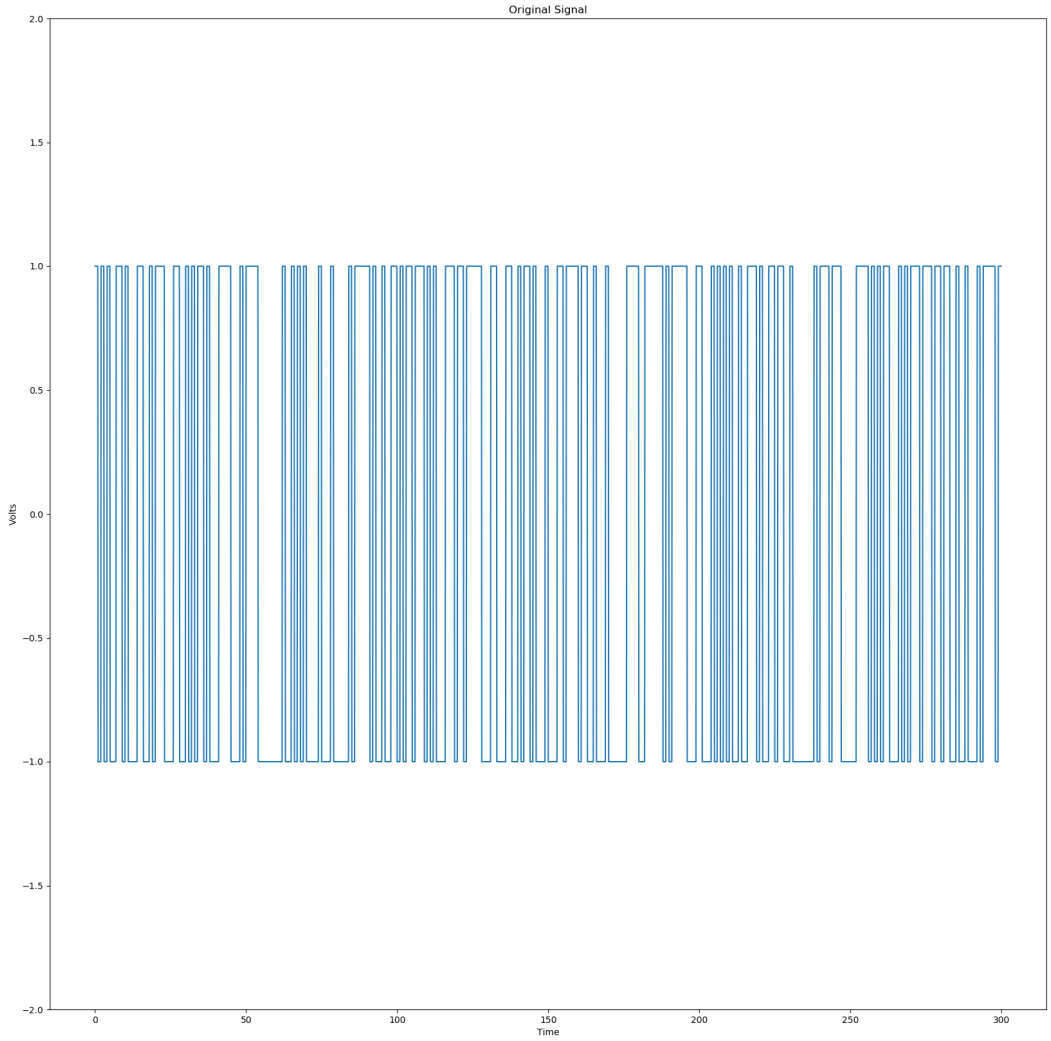
Answer. Plot 1 shows the output for the 3 cases:

- The receive filter $h(t)$ is a matched filter with unit energy.
- The receive filter $h(t)$ is not existent (i.e. $h(t) = \delta(t)$).
- The receive filter $h(t)$ has the givent impulse response.

Plot 2 shows the original signal.



Plot 1: The output of the receive filter for the 3 cases.

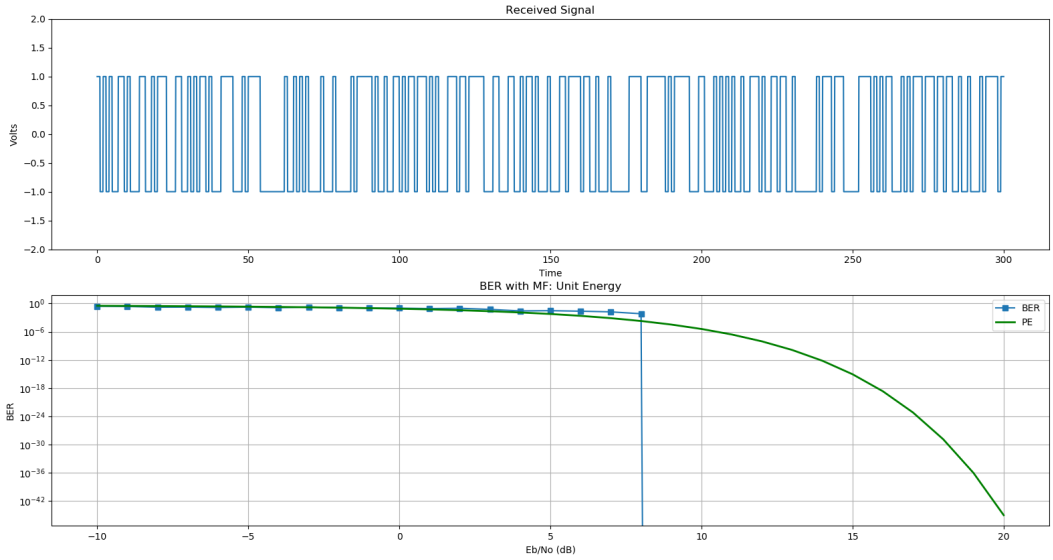


Plot 2: The original signal.

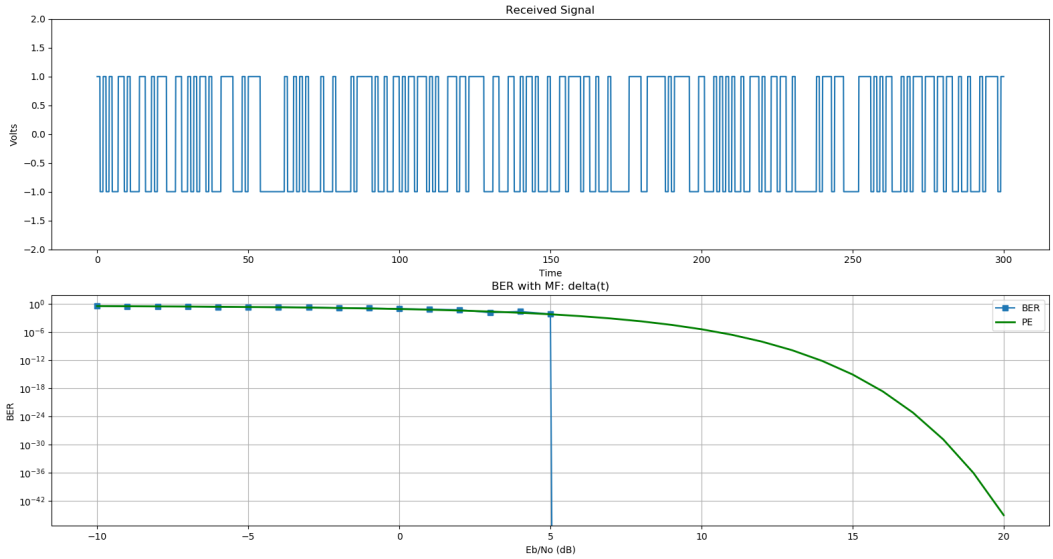
Requirement 3

On the same figure, plot the Bit Error Rate (BER) Vs E/N_0 (where E is the average symbol energy) for the three mentioned cases. Take E/No to be in the range -10 dB: 20:dB. (Use a semilogy plot).

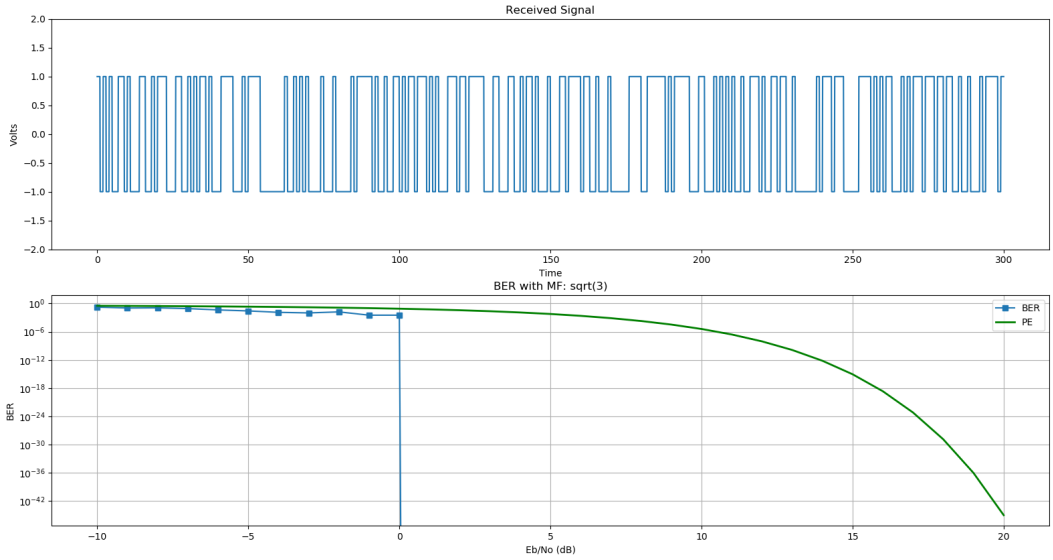
Answer. Plots 3, 4 and 5 are the required plots.



Plot 3: The receive filter $h(t)$ is a matched filter with unit energy.



Plot 4: The receive filter $h(t)$ is not existent (i.e. $h(t) = \delta(t)$).



Plot 5: The receive filter $h(t)$ has the givent impulse response.

Requirement 4

Is the BER an increasing or a decreasing function of E/N_0? Why?

Answer. BER is a decaying curve. As E/N_0 increases the signal to noise ratio increases (signal power $\gg$ noise). So the bit rate error decreases.

Requirement 5

Which case has the lowest BER? Why?

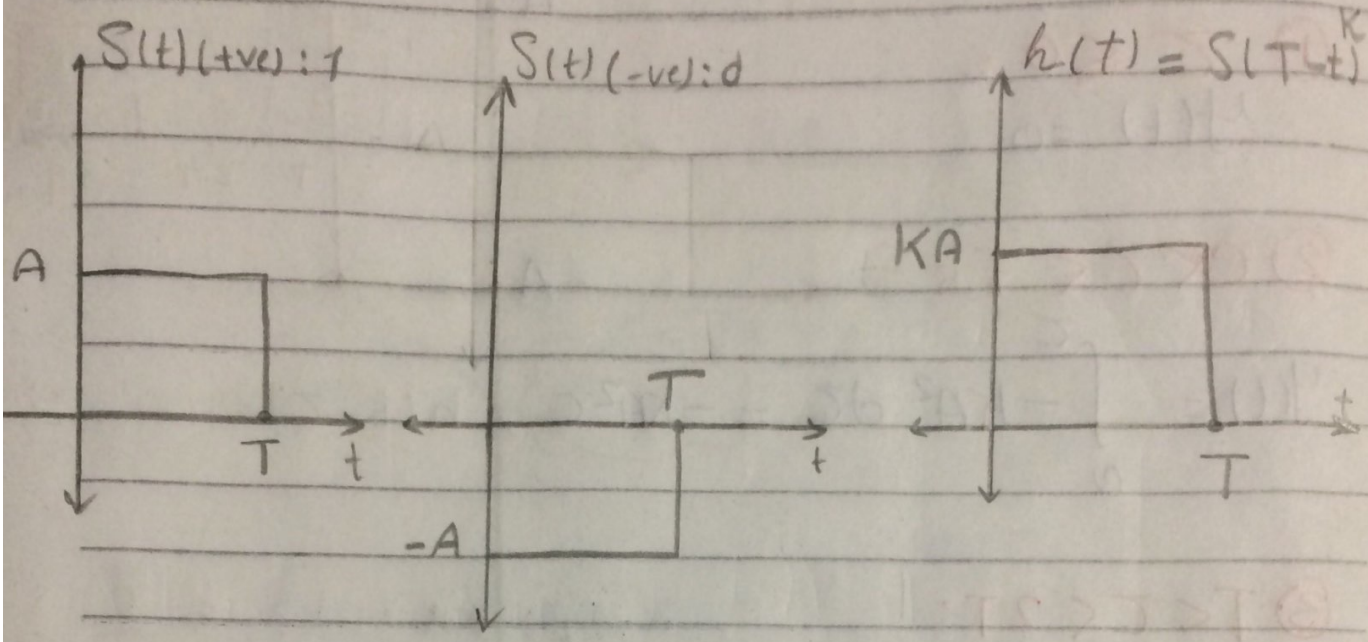
Answer. From the plotted graphs, the third matched filter (MF = $\sqrt{3}$) has the best BER, it reaches '0' faster than the other two cases, nearly at SNR = 0

Part I

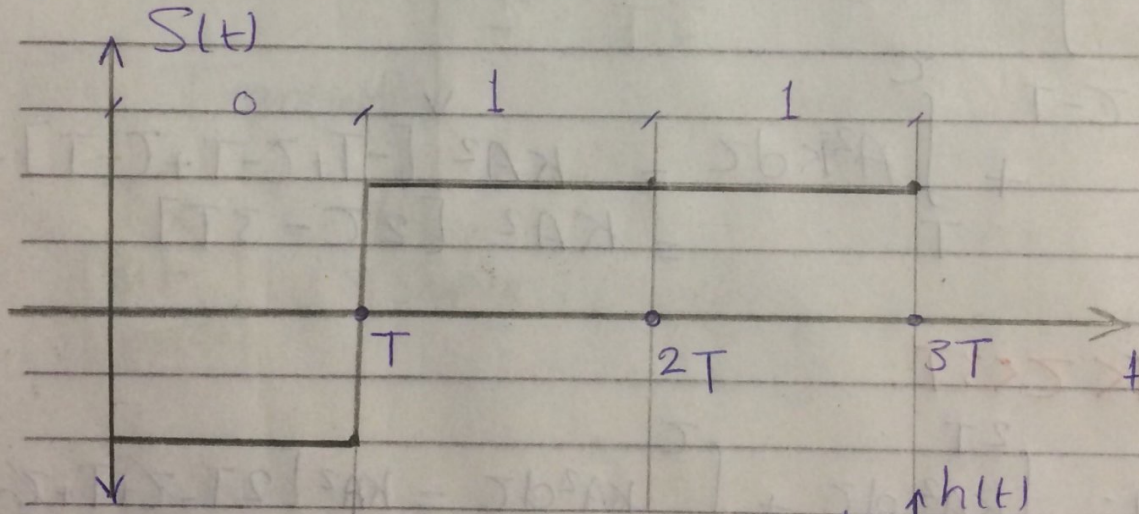
The following pages are the scanned answers for part 1.

Date :_____ No:_____

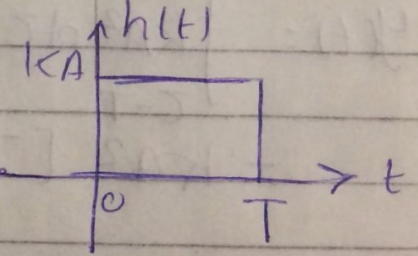
Prob1 :-



(a) b: 0, 1, 1



(b) MF : $h(t) = K\, S(T-t)$

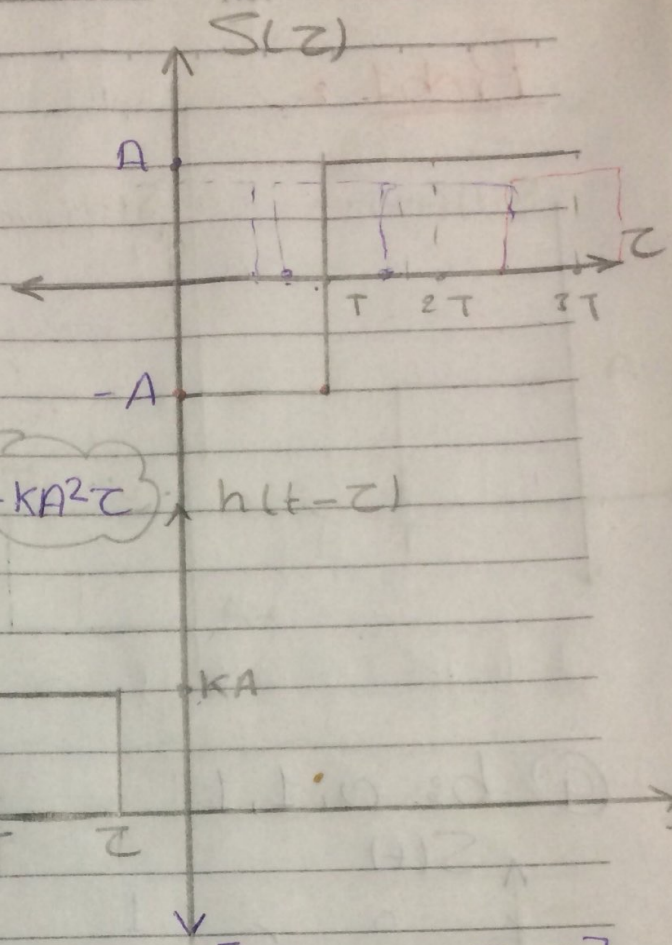


τ - T < 3T

Date: No:

(b)

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



① $\tau \leq 0$:

$y(t) = 0$

② $0 < \tau < T$:

$$y(t) = \int_0^{\tau} -KA^2 \, d\tau = -KA^2\tau$$

③ $T < \tau < 2T$:

$$y(t) = \int_{\tau-T}^{T} -KA^2 \, d\tau + \int_{T}^{\tau} A^2K \, d\tau = KA^2[-T+\tau-T+\tau-T]$$

$$= KA^2[2\tau - 3T]$$

④ $2T < \tau < 3T$:

$$y(t) = \int_{\tau-T}^{2T} KA^2 \, d\tau + \int_{2T}^{\tau} KA^2 \, d\tau = KA^2[2T - \tau + T + \tau - 2T]$$

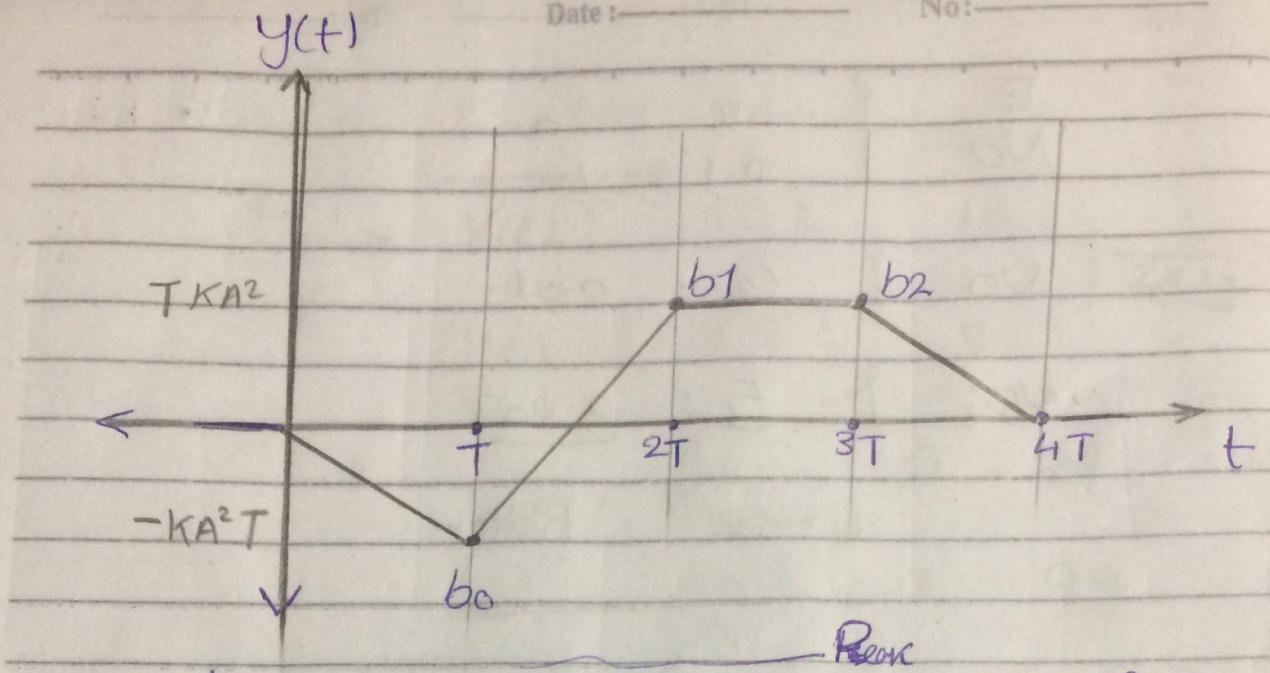
$$= KA^2[T] \text{ , fixed/const.}$$

⑤ $3T < \tau < 4T$:

$$y(t) = \int_{\tau-T}^{3T} KA^2 \, d\tau = KA^2[3T - \tau + T]$$

$$= KA^2[-\tau + 4T]$$

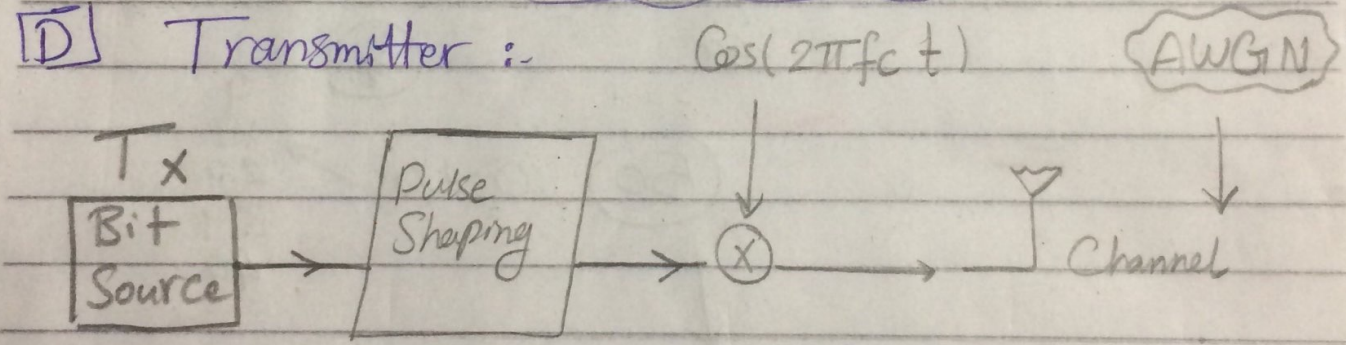
⑥ $\tau > 4T$: $y(t) = 0$ #



Recv

C b_0 Sampled at T Value: $-KA^2T$
b_1 ~ 2T Value: KA^2T
b_2 ~ 3T Value: KA^2T

D Transmitter :-



Receiver :-