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Mid ExamI. **Dig. Comm 0953422** **12/11/2014**

17/30

Q.1 (8 Points)

In a binary baseband system, the shown signals are used. Find the average energies and the correlation coefficient (levels are ±1).

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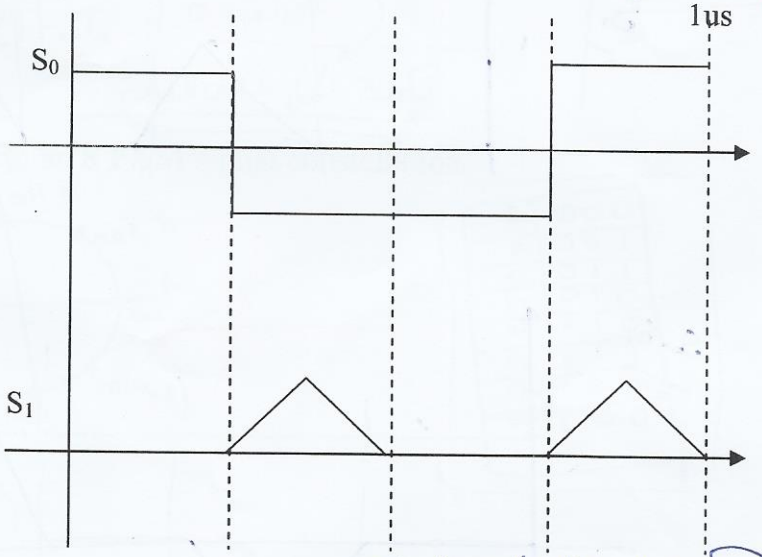
ρ_{01} = 0

E_0 = $1 * 10^{-6}$

E_1 = $0.25 * 10^{-6}$



3

$\rho_{01} = \frac{\int_T s_0 s_1}{|s_0||s_1|}$

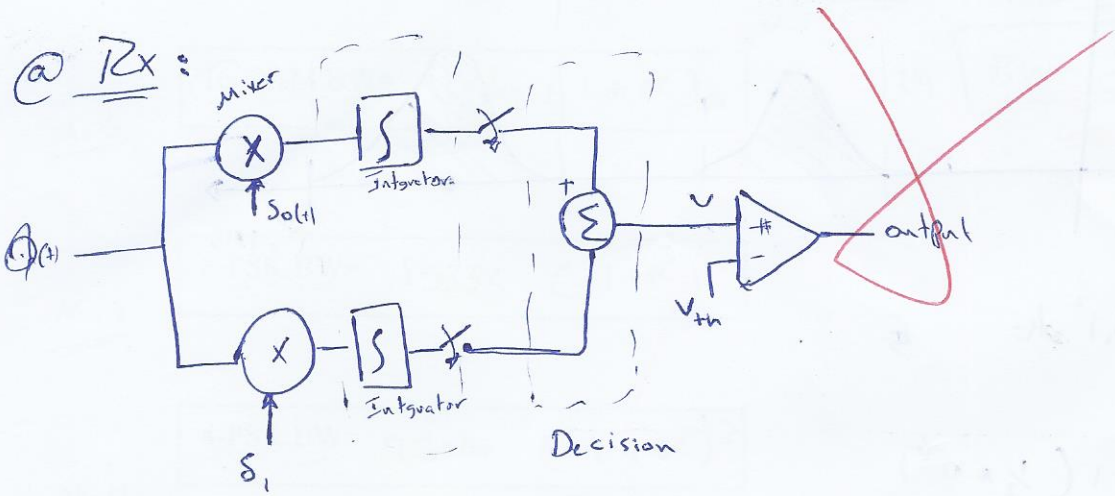
$\Rightarrow \int_T s_0 s_1 =$ Zero ∴

هل السؤال خلف الورقة

Draw the matched filter receiver block diagram for these signals.

s_0 & s_1 are orthogonal [$\rho_{01} = 0$]

@ Rx :



Q.2 (10 Points)

1- Compare the average energy of a **16 PSK** and a **16 QAM** constellations if d_{min}=2 and data rate of **64kbps**.

$r_b = 64$ kbps $d_{min} = 2$

$T_s = \frac{1}{r_b}$

$T_s = \frac{1}{64 * 10^3}$

$T_s = 1.5625 * 10^{-5}$

For QAM

$E_{avg} = \frac{4\left(\frac{d_{min}^2}{2} + \frac{20\, d_{min}^2}{4} + \frac{18\, d_{min}^2}{4}\right)}{16} \cdot T_s = 1.5625 * 10^{-4}$

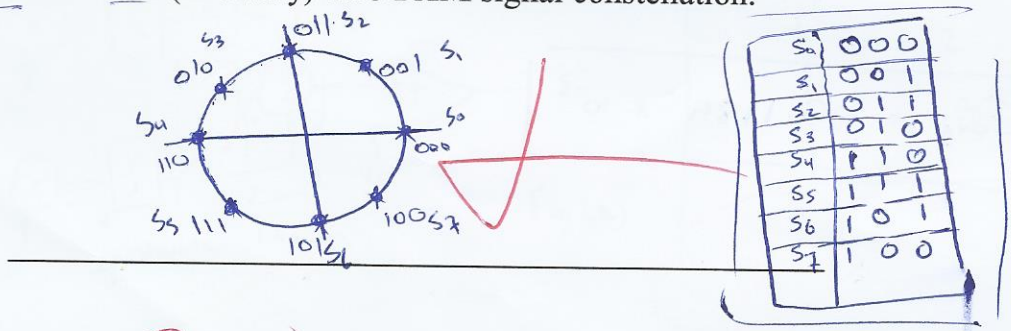
For PSK:

$E_{avg} = \left[\frac{d_{min}^2}{4} \Big/ \sin^2\left(\frac{\pi}{16}\right)\right] \cdot T_s = 9.11 * 10^{-3}$

(*) QAM is better than PSK

تكملة الحل خلف الورقة

2- Draw and label (in binary) an **8 PAM** signal constellation.



S_0	0 0 0
S_1	0 0 1
S_2	0 1 1
S_3	0 1 0
S_4	1 1 0
S_5	1 1 1
S_6	1 0 1
S_7	1 0 0

5

3- Find the required channel BW if the bit rate is **48kbps**? (*) $r_b = 48$ kbps

(*) $BW = \frac{r_b}{\log_2 M}(1+\alpha)$

base band

M=16 16-QAM BW= $11500\,(1+\alpha)$

M=8 8-PSK BW= $15333\,(1+\alpha)$

M=4 4-PSK BW= $23000\,(1+\alpha)$

Q.3 (8 Points) ABET Question r_b BW

It is required to transmit a 64kbps binary data through a **20KHz channel** using a base-band system. Design the signal constellation, write the expression for the transmitted signal and draw the transmitter and the coherent receiver block diagrams.

@ Tx

(*) Signal Constellation :

Fig (1)

(*) Coherent Reciever

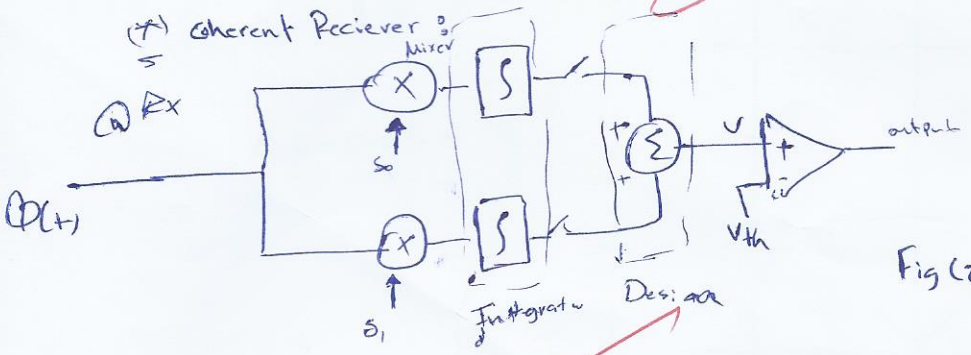


Fig (2)

BW = 20 kHz

r_b = 64 kbps

m = 2

α = - 0.375

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$BW = \frac{r_b}{\log_2 M}$ Φ(t)?

$\therefore \log_2 M = \frac{r_b}{BW} = \frac{64 * 10^3}{20 * 10^3} = 3.2$

But "(20 kHz)" is the Bandwidth of channel

$BW_{message} < BW_{channel}$

$\therefore$ ~~M =~~ $\log_2 M = 2 = m$

$\therefore |m = 2|$

new $BW = \frac{r_b}{2 \log_2 M} (1 + \alpha)$

$(1+\alpha) = \frac{BW * \log_2 M}{r_b}$

$\alpha = \frac{BW * \log_2 M}{r_b} - 1$

$\alpha = \frac{20 * 10^3 * 2}{64 * 10^3} - 1$

$\alpha = - 0.375$

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Q.4 (4Points)

1.	In band limited transmission, the required channel bandwidth depends only on data rate.	T	(F)
2.	Raised cosine filter is used to limit the signal bandwidth.	(T)	~~F~~
3.	Matched filter limits the noise bandwidth.	(T)	F
4.	ISI happens when the signal BW less than the channel BW.	T	~~F~~