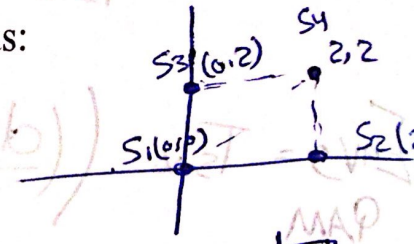
Q.1 **(8 Points 1x2x1x2x2)**

In a baseband system, the constellation points are given as:

S1=(0,0), S2=(2,0), S3=(0,2) and S4=(2, 2)



1- How many axis we need to represent these signals.

2- If binary transmission is needed which signals you select.

3- Find the average energy for the 4 signals at bit rate=1Kbps.

4- Find the PAPR for the 4 signals.

5- How to make these signals minimum energy keeping the same distances between them.

Transmit in QAM Modulation give us minimum Energy

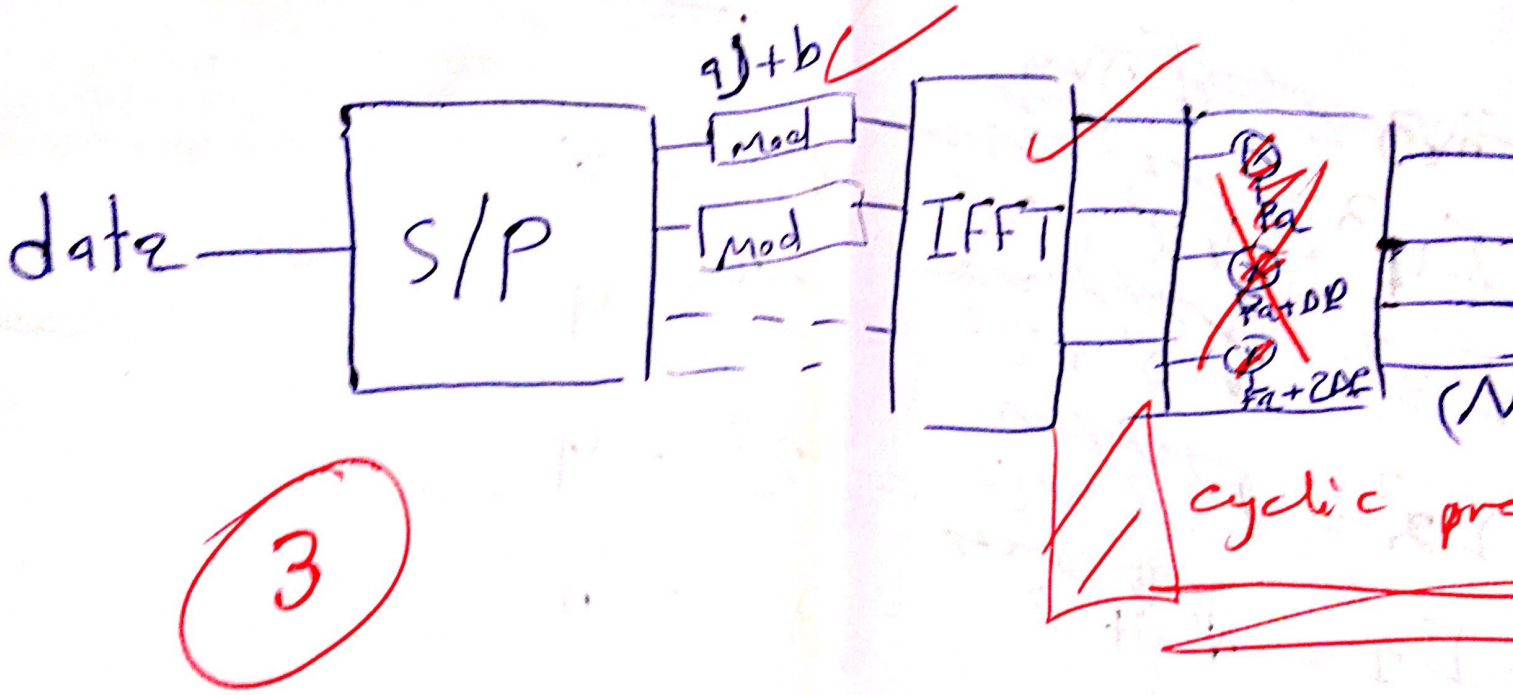
$r_b = 1$ Kbps

$T_s = m T_b$

$T_s = \frac{m}{r_b} = \frac{1}{1000}$

Q.3 **(5 Points)**

Draw and label the block diagram for OFDM system.



3

Q.4 (12 Points 6x6) ABET Question

A- It is required to transmit a 80kbps binary data through a **25KHz channel** using a **base-band system**. Design and draw the signal constellation, write the expression for the transmitted signal. Draw the transmitter block diagram

BW

$B = \frac{r_b}{2m}(1+\alpha)$ $m=1$

$\alpha = -0.375 \rightarrow$ Not practical α can't be negative.

wrong method

$B = \frac{r_b}{2m}(1+\alpha)$ $m=2$.

$\alpha = 0.25$ → Practical good solution

$r_b = .8$

$T_s =$

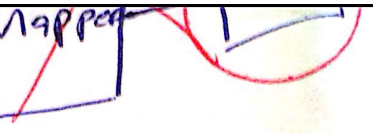
(2)

10 11 01 00

Expression = $s(t) = \frac{\text{Sinc}\left(\frac{t}{T}\right)\cos\left(\frac{\pi\alpha t}{T}\right)}{1-\left(\frac{t*2\alpha}{T}\right)}$

Tx — Mapper

Xpression = $s(t) = \frac{\text{Sinc}(\frac{t}{T})}{1-\left(\frac{t*2\alpha}{T}\right)}$



B- It is required to transmit a 80kbps binary data through a **25KHz fading channel** using a **band-pass system at 1MHz**. Design and draw the best signal constellation (minimum bandwidth and energy), write the expression for the transmitted signal. Draw the transmitter block diagram.

FSK

$R_{bb} = r_b(1+\alpha)$ $m=1$