

* Lab 5 *

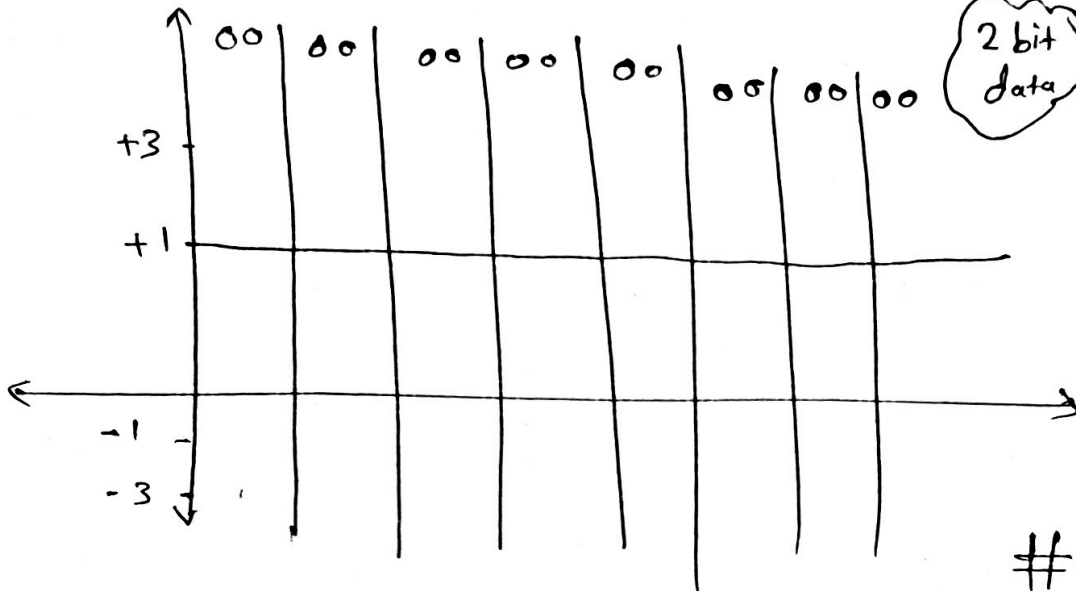
Chapter 4 - part (2)

P4-7 : Repeat P4-3 for 2B1Q.

	+ve Signal	-ve level
00	+1	-1
01	+3	-3
10	-1	+1
11	-3	+3

a) 0000 0000 0000 0000 .

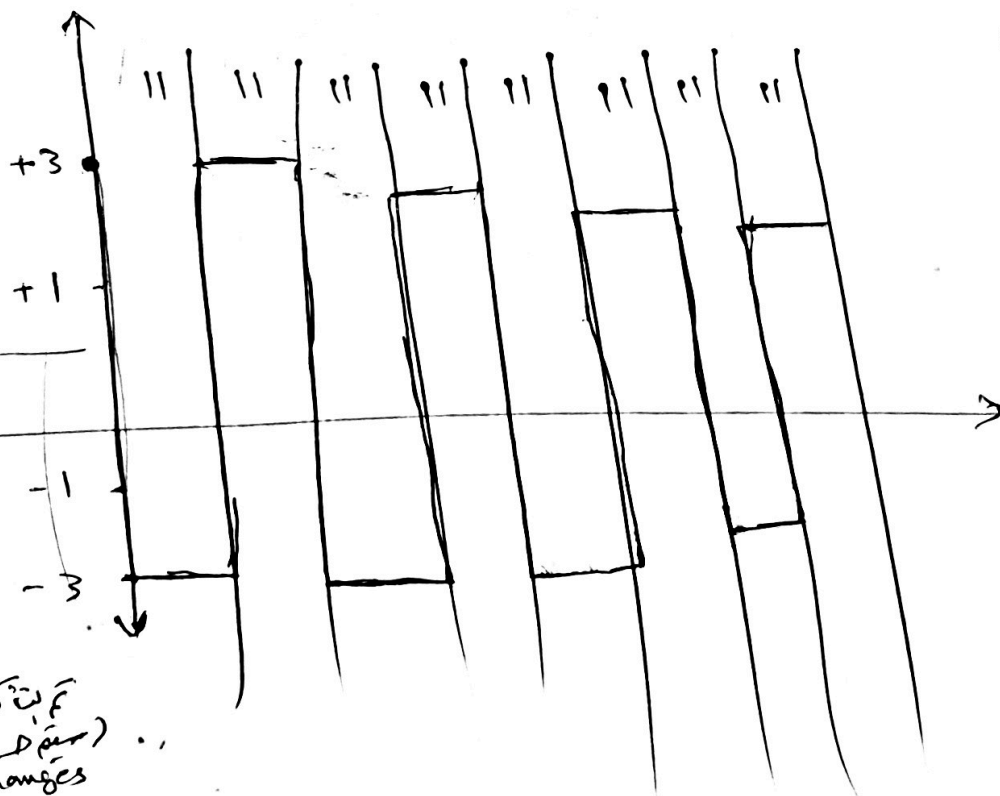
Sol:



#changes = 0

b) 1111 1111 1111 1111

Sol:

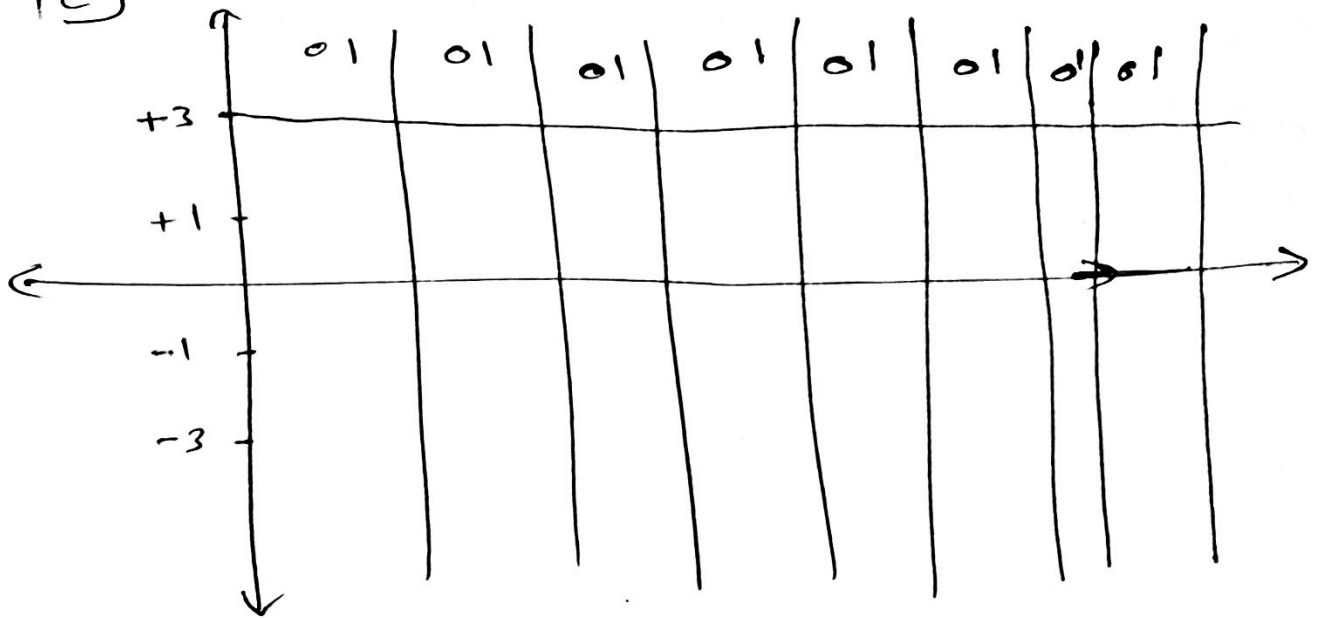


#changes = 8

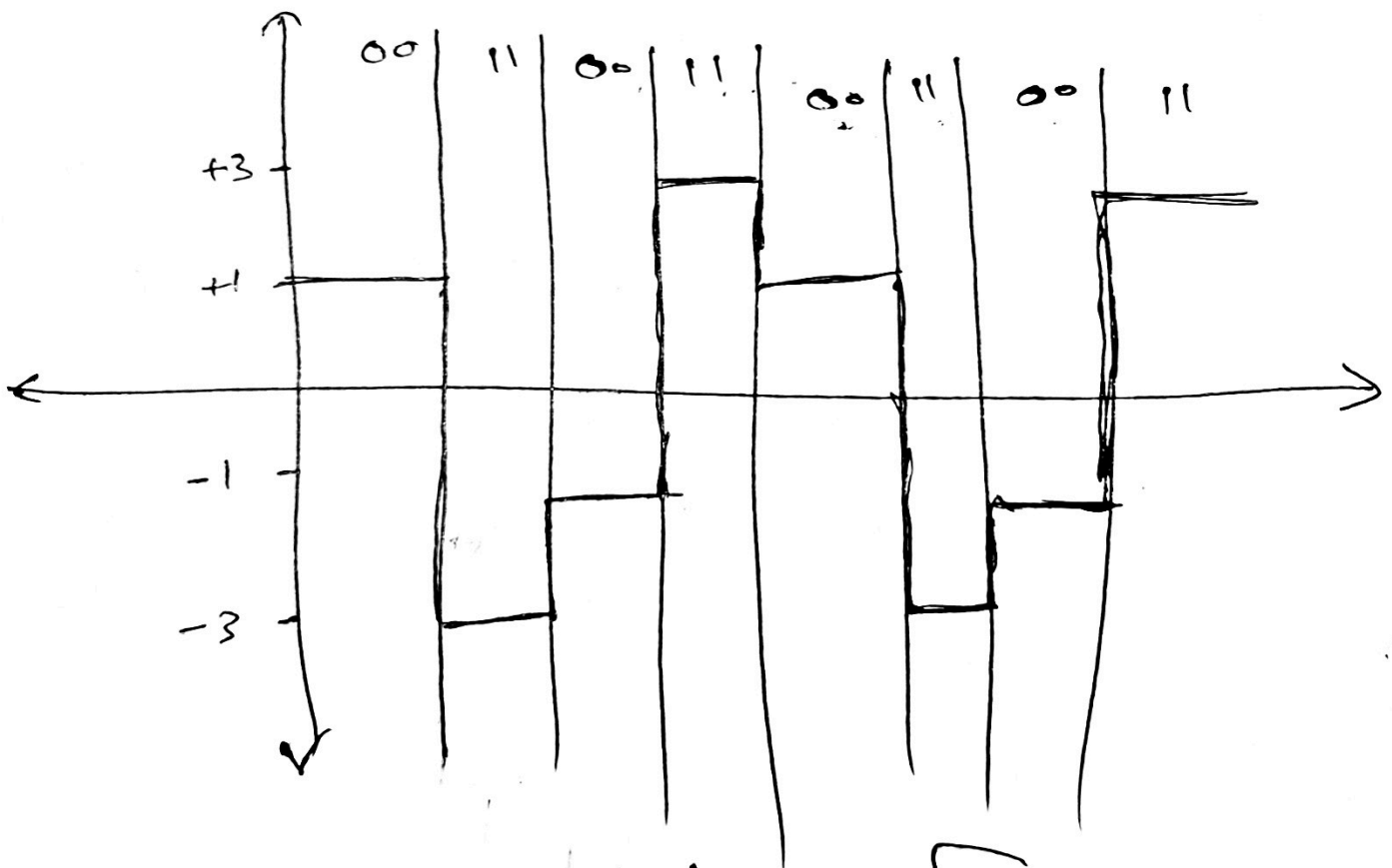
يوجد حلول
لا تقبل
هذا
Change
الربط
المستند
وكتبه

بمبدأ
(مبدأ التغييرات)
① changes

(c)



changes = (0)

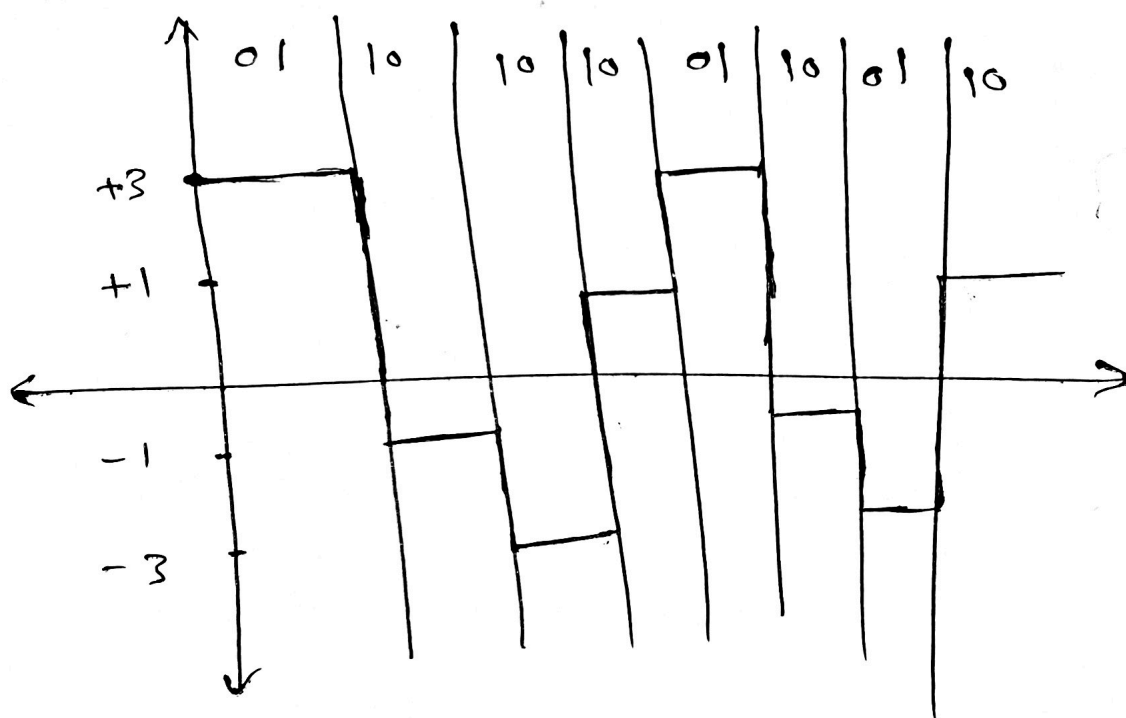


changes = (7)

$$\text{avg. of changes} = \frac{0 + 8 + 0 + 7}{4} = \boxed{3.75}$$

$$B = \left(\frac{3.75}{16} \right) N \quad \#$$

814 (8)



changes = 7

⇒ P4-q:

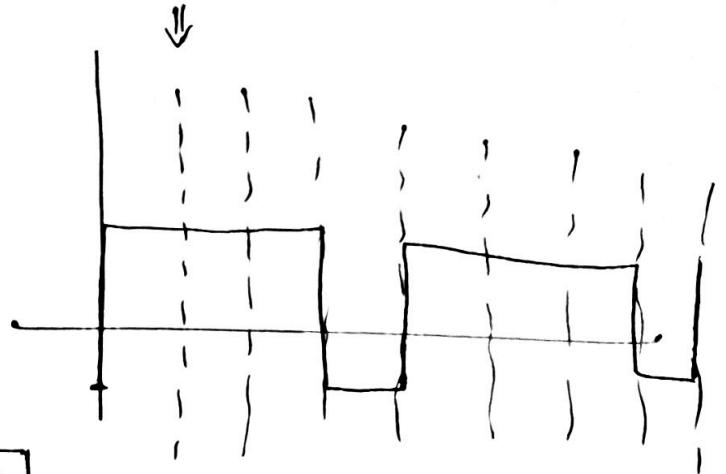
Find the 8-bit data stream for each case.

(a) NRZ-I.

Next bit is 1
→ inversion

Next bit is 0
no inversion

(بسط في السالب)



Answer: 10011001

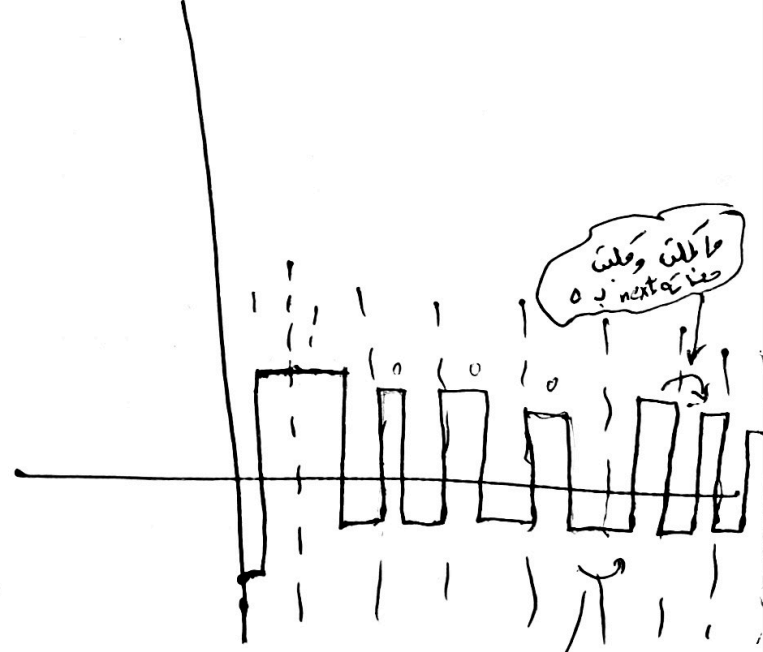
مبدأ الإرسال، كانت بالسالب
وعلقت الموجب (لأنه يلي جاي بـ 1)

Next بـ 0
(عشان حافظت على
الـ 0) ⇒ 000

(b) differential Manchester

Next bit is 0
→ inversion

Next bit is 1
→ no-inversion



تاليه صافه، next بـ 0

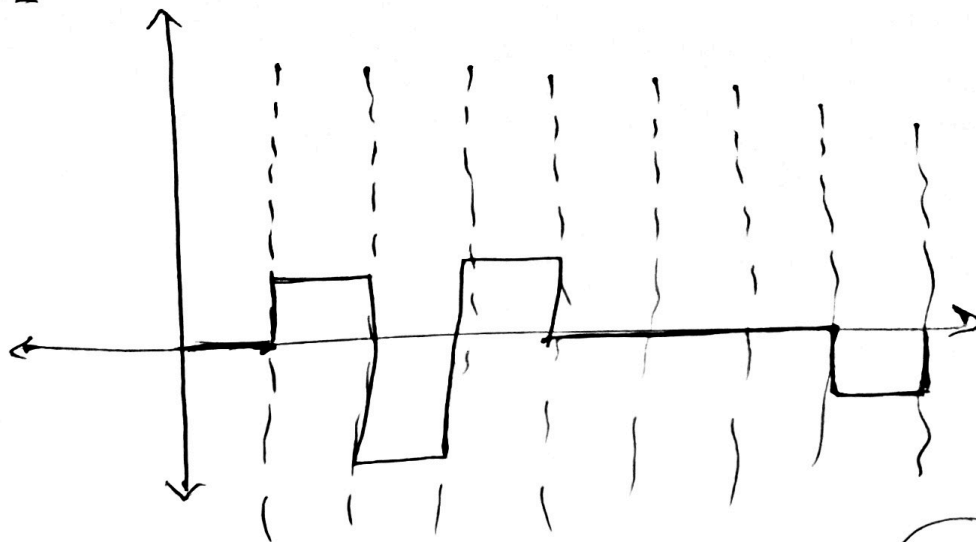
Answer: 11000100

الاشارة جايه بالسالب، وحافظت على
مسيرها (صافه، next بـ 1)

كانت لاشارة
ميرضا صافه
الـ next بـ 1

كانت لاشارة
صافه
next بـ 1

© AMI



⇒ Answer:

0 1 1 1 0 0 0 1

⇒ AMI:

bit (0) ⇒ Zero

bit (1) ⇒ +ve $\bar{c}_p$
-ve $\bar{c}_p$

P 4-10:

NRZ-I $\Rightarrow$ N (data Rate) = 100 kbps.

- $\hookrightarrow$ using Figure 4.6
- $\hookrightarrow$ find the normalized energy (P) .
- $\hookrightarrow$ for freq. 0 Hz, 50 kHz, 100 kHz.

Sol:

freq. $\Rightarrow f/N$ $\Rightarrow$ f/N $\Rightarrow$ f/N

(a) at 0 Hz.

$$\frac{f}{N} = \frac{0}{100k} = 0, \text{ when } f/N = 0, \boxed{P = 1}.$$

(b) at 50 kHz.

$$\frac{f}{N} = \frac{50k}{100k} = \left(\frac{1}{2}\right), \text{ when } f/N = \frac{1}{2}, \boxed{P = 0.5}.$$

(c) at 100 kHz.

$$\frac{f}{N} = \frac{100k}{100k} = 1, \text{ when } f/N = 1, \boxed{P = 0}$$

P4.11:

Manchester signal $\Rightarrow$ data rate = 100 kbps.

$\Rightarrow$ using figure 4.8.

$\Rightarrow$ Value of normalized energy (P) = ?

for freq. 0 Hz, 50 KHz, 100 KHz

Sol:

Frequency $\propto f/N$ $\rightarrow$ P $\rightarrow$ f/N
figure 4.8 $\rightarrow$ P $\rightarrow$ f/N

① 0 Hz:

$$\frac{f}{N} = \frac{0}{100 \text{ K}} = \boxed{0}, \text{ when } f/N = 0 \text{ then } \boxed{P=0} \text{ (by using figure)}$$

② 50 KHz:

$$\frac{f}{N} = \frac{50 \text{ K}}{100 \text{ K}} = \boxed{\frac{1}{2}}, \text{ when } f/N = \boxed{0.5}, P = \boxed{0.3}.$$

③ 100 KHz:

$$f/N = \frac{100 \text{ K}}{100 \text{ K}} = \boxed{1}, \text{ when } f/N = \boxed{1}, P = \boxed{0.4}.$$

($\rightarrow$ P $\rightarrow$ f/N)

P4.12: input stream to 4B/5B block encoder is:

0100 0000 0000 0000 0000 0001

(a) What the output of stream?

Sol:

4.2 bits

01010 1110 11110 11110 11110 01001

(b) What is the length of the longest consecutive seq. of 0's in the input?

Sol:

21

(c) What is the length of the longest consecutive seq. of 0's in the output?

Sol:

2

#

4B/5B

⇒ used always with NRZ-I.

⇒ NRZ-I is good signal rate, but it has a synchronization problem.

⇒ A long sequence of 0's can make the receiver block lose synchronization.

⇒ P 4-13: How many invalid (unused) code sequencey?

Sol.

⇒ 5B/6B: $2^5 = 32$ code seq.
 $2^6 = 64$ code seq.

∴ # of unused = $64 - 32 = \boxed{32}$

⇒ 3B/4B: $2^3 = 8$
 $2^4 = 16$

∴ # of unused code seq = $16 - 8 = \boxed{8}$

⇒ P 4-14: ⇒ Sequence 111 000 000 000 000. Sampling??
 ⇒ Assume that the last non zero signal level +ve.

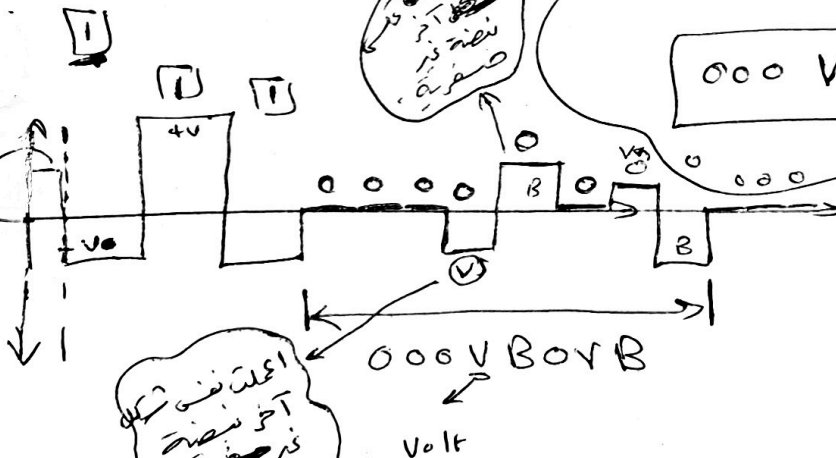
ب لقي
على
آخر plus
غير صفرية

(a) B8ZS
 ← Bipolar

لو كنا 8 أبيت - واحد ببيت
 بنجوز مكانهم:

000 V B 0 V B

V نفس
قطعة
النقطة
الافقية
غير
السالبة



اعلمت نفس
آخر نقطة
غير صفرية

Bipolar

bit(0) ⇒ zero.

bit(1) ⇒ +V و -V

(b) HDB3
 ↑

P4-15: Nyquist sampling rate?

(a) low-pass with BW of 200 kHz.

Sol:

$$f_{\max} = 200 \text{ kHz}$$

$$f_{\max} = 0 + 200 = 200 \text{ k}$$

$$\therefore f_s = 2 \times f_m \Rightarrow f_s = 2 \times 200 \text{ k} = 400 \text{ k sample/sec}$$

(b) band-pass with BW of 200k if lowest freq 100k

Sol:

$$f_{\max} = 100 + 200 = 300 \text{ kHz}$$

$$f_s = 2 \times f_{\max}$$

$$= 2 \times 300 \text{ k} = 600 \text{ k sample/sec}$$

P4-16: low-pass signal with BW of 200kHz using 1024 quantization.

(a) bit rate of digitized signal.

$$BW = f_{\max} - f_{\min}$$

$$200 = f_m - 0$$

$$f_m = 0 + 200 = 200$$

Sol:

$$n_b = \log_2 L$$

$$N = f_s \times n_b$$

$\Rightarrow n_b$ (# bits per sample)

$$n_b = \log_2 1024 = 10 \text{ bits/sample}$$

$$\therefore \text{bit rate } (N) = f_s \times n_b = 10 \times 400 \text{ k} = 4 \text{ mbps}$$

$\Rightarrow$ In low-pass
 $f_{\min} = 0$.

$$\Rightarrow f_{\max} = 0 + 200 \text{ k} = 200 \text{ k}$$

$$\Rightarrow f_s = 2 \times f_{\max} = 400 \text{ k sample/sec}$$

⑥ SNR_{dB} .

Sol:

$$SNR_{dB} = 6.02 * n_b + 1.76$$

$$= 6.02 * 10 + 1.76$$

$$= \boxed{61.96} \text{ dB}$$

⑦ PCM ??

Sol:

$$PCM = n_b * B_{analog}$$

$$= 10 * 200 \text{ KHz}$$

$$= \boxed{2 \text{ MHz}}$$

P4-17

maximum
~~minimum~~

data rate ? $\Rightarrow BW = 200 \text{ KHz}$

$\Rightarrow$ use 4 levels.

Sol:

$$N_{max} = 2 * BW * n_b$$

$$= 2 * 200 \text{ K} * \log_2 4 =$$

$$\boxed{800 \text{ Kbps}}$$

⇒ P4-18 :

⇒ $BW = 20\text{ KHz}$

⇒ 30 kbps channel.

⇒ $SNR_{dB} ??$

↓
(bit rate)

Sol :

$$SNR_{dB} = 6.02 * n_b + 1.72$$

$$= 6.02 * 1 + 1.72 = \boxed{7.74}$$

db

$n_b = ??$

$$f_{max} = 20\text{K} + 0 = \boxed{20\text{ KHz}}$$

$$f_s = 2 * f_{max} = \boxed{4000 \text{ sample/s}}$$

$$n_b = \frac{\text{Bit Rate}}{\text{Sample Rate}} = \frac{\text{Bit Rate}}{f_s} \Rightarrow \begin{matrix} \text{no bit} \\ \text{Bit} = f_s * n_b \\ \text{rate} \end{matrix}$$

$$n_b = \frac{3000}{4000} = \boxed{0.75} \approx \boxed{1}$$

⇒ P4-19 :

base-band with $BW = 1\text{M}$

data rate ?

(a) NRZ-L : $B = \frac{N}{2} \Rightarrow N = 2 * 1\text{M} = \boxed{2\text{Mbps}}$

(b) Manchester : $B = N \Rightarrow N = \boxed{1\text{Mbps}}$

(c) MLT : $B = N/3 \Rightarrow N = 3 * 1 = \boxed{3\text{Mbps}}$

(d) 2B1Q : $B = N/4 \Rightarrow N = \boxed{4\text{Mbps}}$

P4-20 : $\rightarrow$ we want to transmit 1000 characters.
 $\rightarrow$ each character encode in 8 bits.

(a) # bit for sync.

Sol: $1000 \times 8 = \boxed{8000 \text{ bits}}$

(b) # bit for asyn.

Sol: (start bit + data + end bit) $\Rightarrow$ 10 bit for each char.

$$1000 \times 10 = \boxed{10000 \text{ bits}}$$

(c) redundancy percent.

In (a) : no redundancy bit.

$$(b) : \frac{2}{10} = \boxed{0.2}$$