



12 Pages

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners can either ignore illegible script or have it typed and the expense of typing charged to the candidate.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
6. No part of this book is to be torn out; it must be handed in complete.
7. If more books than one are used, fasten them together using the tags available from the invigilator(s).
8. **Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the examination venue.**

Darius

Rhyme

List the numbers of the questions you have attempted	Office Use
4a)	4
b)	10
c)	2
2 b)	8
1 b)	10
2 a)	2
Total	32 / 60 160%

(Gweler yr ochr arall am y fersiwn Cymraeg)

✓ 76/60
Original SPM

4a) $x(k) = 2, 3, 2, 1$
 $h(k) = 2, 1, 2, 3$

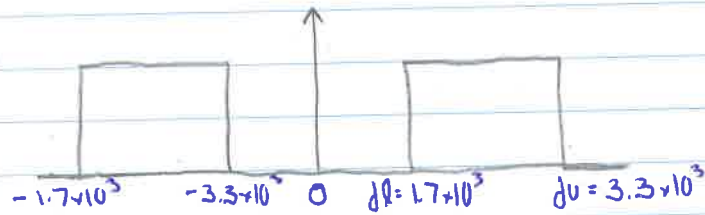
$$\begin{array}{cccc}
 & 2 & 3 & 2 & 1 \\
 3 & 2 & 1 & 2 & \\
 & 3 & 2 & 1 & 2 \\
 & & 3 & 2 & 1 & 2 \\
 & & & 3 & 2 & 1 & 2 \\
 & & & & 3 & 2 & 1 & 2 \\
 & & & & & 3 & 2 & 1 & 2
 \end{array}$$

$$\begin{aligned}
 y(0) &= 2 + 2 = 4 \\
 y(1) &= 2 + 6 = 8 \\
 y(2) &= 4 + 3 + 4 = 11 \\
 y(3) &= 6 + 6 + 2 + 2 = 16 \\
 y(4) &= 9 + 4 + 1 = 14 \\
 y(5) &= 6 + 2 = 8 \\
 y(6) &= 3
 \end{aligned}$$

4

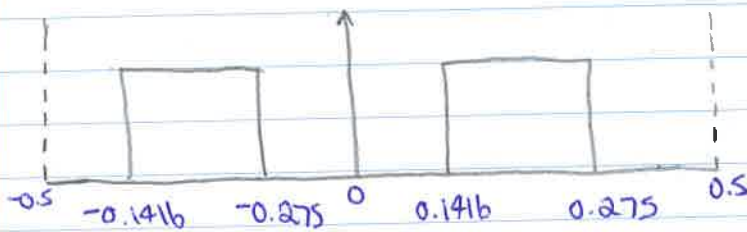
4b) $\alpha = N - 1/2 = 3$

$\Delta f = 1.2 \times 10^4$



Convert frequencies to normalization

$V_U = \frac{\Delta U}{\Delta f} = \frac{3.3 \times 10^3}{1.2 \times 10^4}$



$V_U = 0.275$

$V_L = \frac{\Delta L}{\Delta f} = \frac{1.7 \times 10^3}{1.2 \times 10^4}$

$V_L = 0.1416$

$V_0 = \frac{V_U + V_L}{2}$

$V_C = \frac{V_U - V_L}{2}$

$V_0 = 0.2083$

$V_C = 0.0667$

$h_{LP}(k) = \left[\frac{1}{\pi \times (k - \alpha)} \right] \times \sin(2\pi(k - \alpha) \times V_C)$

$A = [2 \cos(2\pi(k - \alpha) \times V_0)]$

4c)

k	$h_{LP}(k)$	A	$h_{BP}(k)$	$W(k)$	$h_{BW}(k)$
0	0.1009	-1.4151	-0.1428	-0.9010	0.1287
1	0.1183	-1.7316	-0.2048	-0.2225	0.0456
2	0.1295	0.5180	0.0671	0.6235	0.0418
3	0.1334	0.4166	0.0556	1	0.0556
4	0.1295	0.5180	0.0671	0.6235	0.0418
5	0.1183	-1.7316	-0.2048	-0.2225	0.0456
6	0.1009	-1.4151	-0.1428	-0.9011	0.1287

10

2

16

2b) $M(x) = 10001$
 $Q(x) = x^3 + x^2 + 1$

$$\begin{array}{cccc} x^3 & x^2 & x^1 & x^0 \\ 1 & 1 & 0 & 1 \end{array}$$

$$\begin{array}{r} 1101 \overline{) 10001000} \\ \underline{1101} \downarrow \\ 1011 \downarrow \\ \underline{1101} \downarrow \\ 1100 \downarrow \\ \underline{1101} \downarrow \\ 00010 \downarrow \\ \underline{0000} \downarrow \\ 0100 \end{array}$$

transmit = 100 = 1 error

(4)

$$\begin{array}{r} 1101 \overline{) 10001100} \\ \underline{1101} \downarrow \\ 1011 \downarrow \\ \underline{1101} \downarrow \\ 1101 \downarrow \\ \underline{1101} \downarrow \\ 0000 \end{array}$$

not complete

CRC
 0 = errors detected

(2)

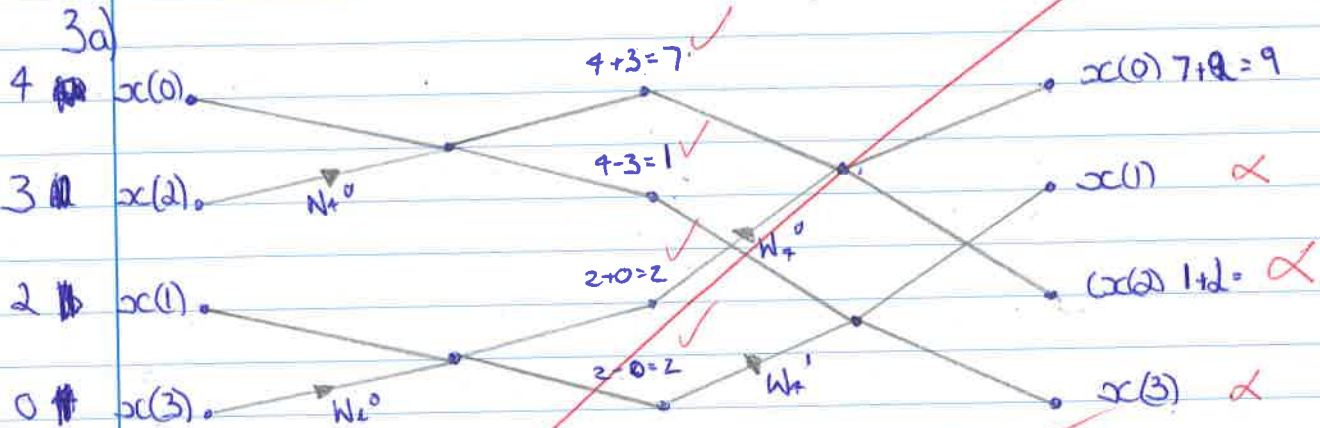
$$\begin{array}{r} 1101 \overline{) 10001000} \\ \underline{1101} \downarrow \\ 1011 \downarrow \\ \underline{1101} \downarrow \\ 1100 \downarrow \\ \underline{1101} \downarrow \\ 00100 \end{array}$$

Not Complete

= 100 = 1 correct error

(2)

(8)



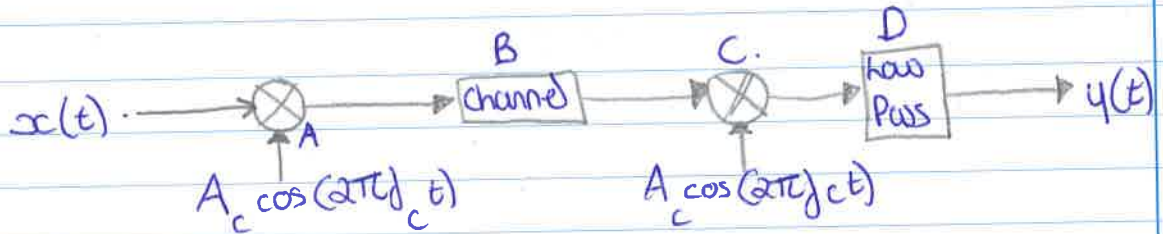
$$x(k) = 4, 2, 3, 0$$

$x^0 \quad x^1 \quad x^2 \quad x^3$

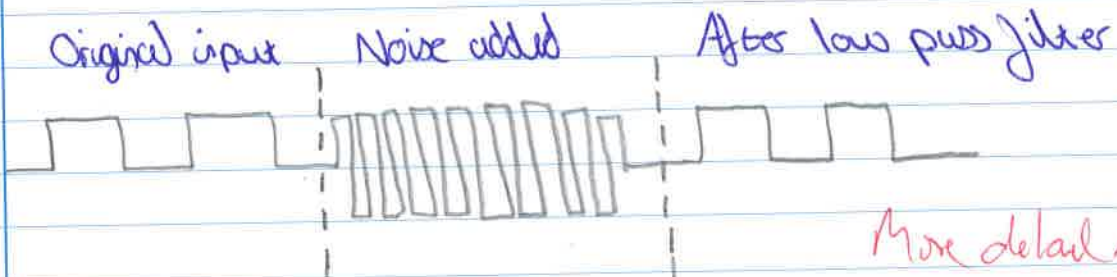
$$W_4^1 = -j$$

Quicker disinter
no more
gates
added

2a)



At ' $x(t)$ ' would be your carrier frequency meeting up with the input signal at point 'A'. That signal then passes through the noise block at point 'B', this simulates the signal as if it was travelling through the world's atmosphere and then it is demodulated back at point 'C'. Point 'D' is called a low pass filter and is used to get the original noisy signal back to its smooth original signal.



More detail needed

$$\text{ODD} = 1$$

1b)

$$\bar{H} = \begin{array}{ccc|ccc} 1 & 0 & 1 & 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 & 1 & 0 \\ 0 & 1 & 1 & 1 & 0 & 0 & 1 \end{array}$$

$$\bar{G} = \begin{array}{ccc|ccc} 1 & 0 & 0 & 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 1 & 1 & 1 & 1 \end{array}$$

$$\bar{T}_1 = \bar{G}_1 \times \bar{U}_1$$

$$= [0101] (0 \oplus 0 \oplus 0 \oplus 1) (0 \oplus 1 \oplus 0 \oplus 1) (0 \oplus 1 \oplus 0 \oplus 1) = 100$$

$$\bar{T}_2 = \bar{G}_1 \times \bar{U}_2$$

$$= [1101] (1 \oplus 0 \oplus 0 \oplus 1) (1 \oplus 1 \oplus 0 \oplus 1) (0 \oplus 1 \oplus 0 \oplus 1) = 010$$

$$\bar{T}_3 = \bar{G}_1 \times \bar{U}_3$$

$$= [1010] (1 \oplus 0 \oplus 1 \oplus 0) (1 \oplus 0 \oplus 0 \oplus 0) (0 \oplus 0 \oplus 1 \oplus 0) = 011$$

$$\bar{T}_1 = 100$$

$$\bar{T}_2 = 010$$

$$\bar{T}_3 = 011$$

(10)

(10)

2b)

$$M(x) = 10001$$

$$G(x) = x^3 + x^2 + 1 = 1101$$

$$\begin{array}{cccc} x^3 & x^2 & x^1 & x^0 \\ 1 & 1 & 0 & 1 \end{array}$$

$$\begin{array}{r} 1101 \overline{) 110001000} \\ \underline{1101} \downarrow \\ 0011 \downarrow \\ \underline{1101} \downarrow \\ 0100 \downarrow \\ \underline{1101} \downarrow \\ 0010 \downarrow \\ \underline{0000} \downarrow \\ 0100 \end{array}$$

Scanned with

Thompson

(2)