



12 Pages

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, fold over 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.**

M Gowan

Adam

Spencer

1	Student Number	P147250
2	Title of Examination Paper	Digital Communications
3	Module Code	M2x8518
4	Date and Time of Examination	18/1/18 15:00
5	Examination Venue	Mount Pleasant
6	Seat Number	
7	Number of Answer Books handed in	1

[illegible]

(Gweler yr ochr arall am y fersiwn Cymraeg)

1)

$$a = 000000 = \text{none} -$$

$$\frac{5\pi}{4} \quad \frac{5\pi}{4} \quad \frac{5\pi}{4}$$

$$b = 011000 = 1 \text{ error} -$$

$$\frac{7\pi}{4} \quad \frac{\pi}{4} \quad \frac{5\pi}{4}$$

$$c = 101010 = 1 \text{ error} -$$

$$\frac{3\pi}{4} \quad \frac{3\pi}{4} \quad \frac{3\pi}{4}$$

$$d = 110110 = \text{none} -$$

$$\frac{\pi}{4} \quad \frac{7\pi}{4} \quad \frac{3\pi}{4}$$

$$e = 110001 = 1 \text{ error} -$$

$$\frac{\pi}{4} \quad \frac{5\pi}{4} \quad \frac{7\pi}{4}$$

$$f = 101101 = \text{none} -$$

$$\frac{3\pi}{4} \quad \frac{\pi}{4} \quad \frac{7\pi}{4}$$

$$g = 011011 = \text{none} -$$

$$\frac{01}{\frac{7\pi}{4}} \quad \frac{10}{\frac{3\pi}{4}} \quad \frac{11}{\frac{\pi}{4}}$$

$$h = 000111 = 1 \text{ Error} -$$

$$\frac{5\pi}{4} \quad \frac{7\pi}{4} \quad \frac{\pi}{4}$$

$\frac{3\pi}{4}$ 10	$\frac{\pi}{4}$ 01
$\frac{5\pi}{4}$ 00	$\frac{7\pi}{4}$ 01

Hamming Code (7,4)

$$H = \begin{bmatrix} 1011 & | & 100 \\ 1101 & | & 010 \\ 0111 & | & 001 \end{bmatrix}$$

$$\bar{G} = \begin{bmatrix} 1000 & | & 101 \\ 0100 & | & 110 \\ 0010 & | & 011 \\ 0001 & | & 111 \end{bmatrix}$$

Double Error
Mark for the third

$$\bar{u}_1 = [0101] (10)$$

$$\bar{u}_1 = [0101] (0 \oplus 1 \oplus 0 \oplus 1) (0 \oplus 1 \oplus 0 \oplus 1) (0 \oplus 0 \oplus 0 \oplus 1)$$

0 0 1

$$\bar{u}_1 = 001$$

(2)

$$\bar{u}_2 = [1101] (1 \oplus 1 \oplus 0 \oplus 1) (0 \oplus 1 \oplus 0 \oplus 1) (1 \oplus 0 \oplus 0 \oplus 1)$$

1 0 0

$$= 100$$

(2)

$$\bar{u}_3 = [1010] (1 \oplus 0 \oplus 0 \oplus 0) (0 \oplus 0 \oplus 1 \oplus 0) (1 \oplus 0 \oplus 1 \oplus 0)$$

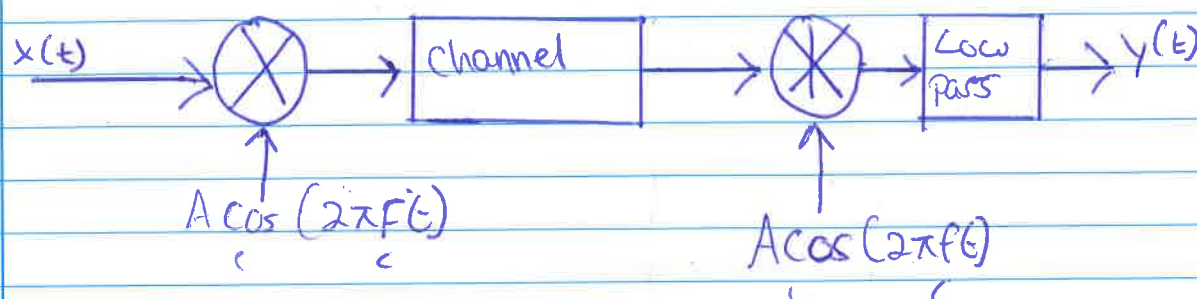
1 1 0

$$= 110$$

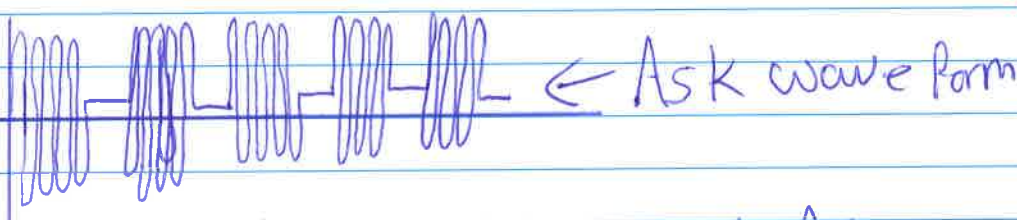
(2)

$$\bar{u}_1 = 001 \quad \bar{u}_2 = 100 \quad \bar{u}_3 = 110$$

2a Amplitude Modulation and Demodulation

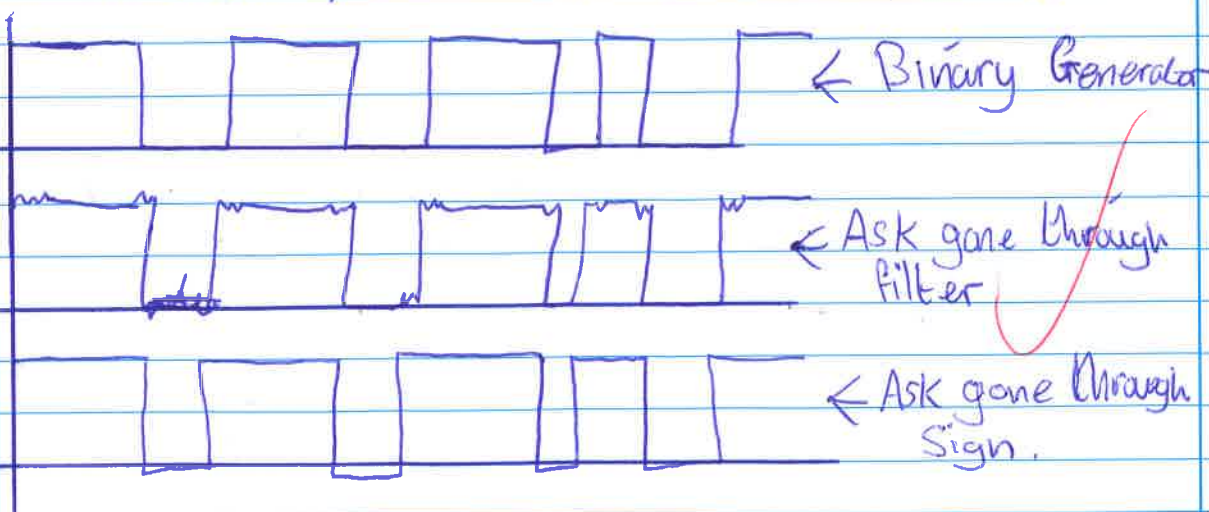


ASK modulation is a frequency that is the same input that come in same time from sine wave form through the switch as the Binary generator did to transfer.

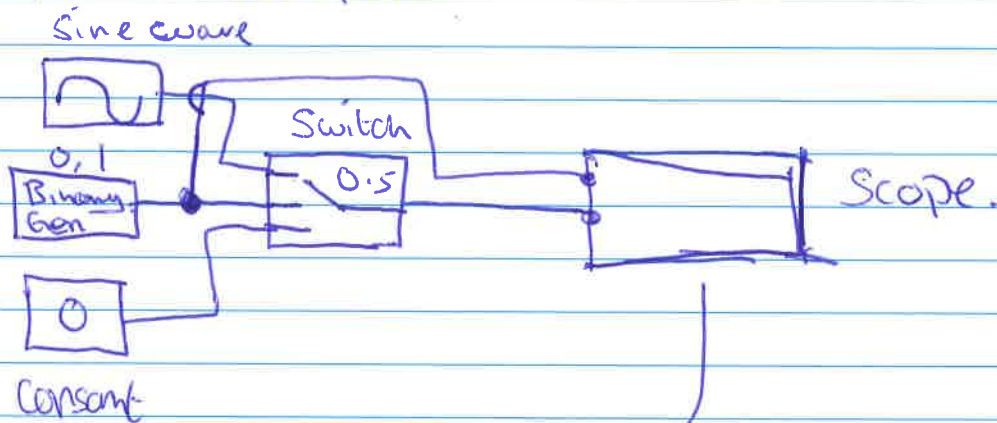


This is the modulation of Ask wave form. It follows pattern of the frequency of Binary Generator above.

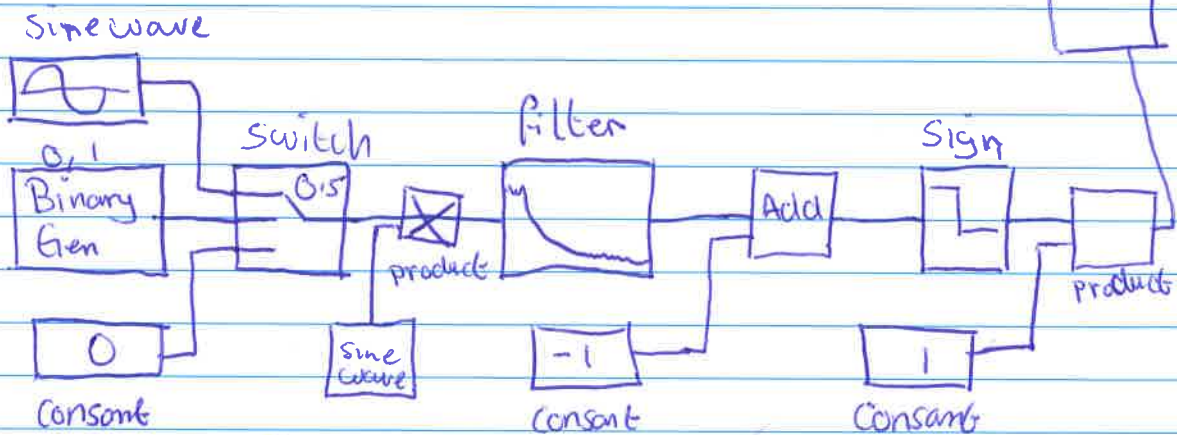
Ask demodulation is the Ask is turned into a looking square wave form, this is done by a filter involved, then a Sign added to Square it.



Modulator Components



De modulator Components



~~When add noise~~

A spectral display
could be useful

(4)

Q2b

CRC

$$M(x) = 10001$$

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

$$G(x) = 1 \ 1 \ 0 \ 1$$

~~1101~~

~~$$\begin{array}{r}
 1101 \overline{) 10001000} \\
 \underline{1101} \\
 1001 \\
 \underline{1001} \\
 0000 \\
 0000 \\
 \hline
 0000
 \end{array}$$~~

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

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

$$M(x) = 10001$$

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

$$G(x) = 1101$$

[illegible]

Transfer Price

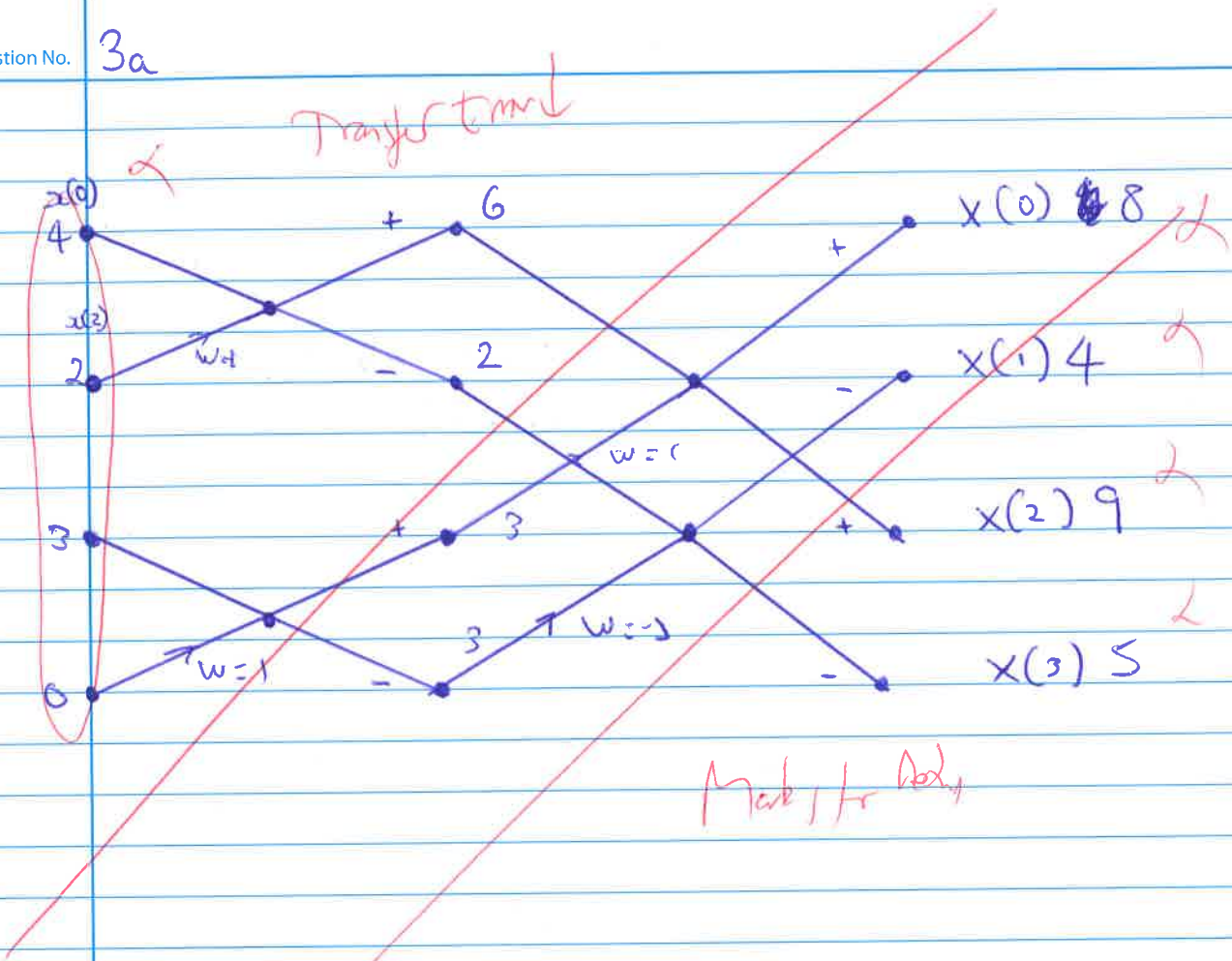
Marks for
Network

[illegible]

NO ERROR

[illegible]

AN Error 7 ↑



Not Used -

Too Many questions there

3b,

4a

linear time.

$$x(k) = \{2, 3, 2, 1\}$$

$$h(k) = \{2, 1, 2, 3\}$$

$$\begin{pmatrix} 2 & 1 & 2 & 3 \\ 3 & 2 & 1 & 2 \end{pmatrix}$$

	2	3	2	1	
3 2 1	2 ⁰				
1 2	1	2 ¹			
3	2	1	2 ²		
	3	2	1	2 ³	
		3	2	1	2 ⁴
			3	2	1
				3	2
					3

$$y(0) = 2 \times 2 = 4$$

$$y(1) = 2 \times 3 + 1 \times 2 = 8$$

$$y(2) = 2 \times 2 + 3 \times 1 + 2 \times 2 = 11$$

$$y(3) = 2 \times 1 + 1 \times 2 + 2 \times 3 + 3 \times 2 = 16$$

$$y(4) = 1 \times 1 + 2 \times 2 + 3 \times 3 = 14$$

$$y(5) = 2 \times 1 + 3 \times 2 = 8$$

$$y(6) = 3 \times 1 = 3$$

(4)

46

Finite Impulse
Band Pass

$$f_e = 1700 \text{ Hz}$$

$$N = 7$$

$$\alpha = \frac{7-1}{2}$$

$$f_u = 3300 \text{ Hz}$$

$$\alpha = 3$$

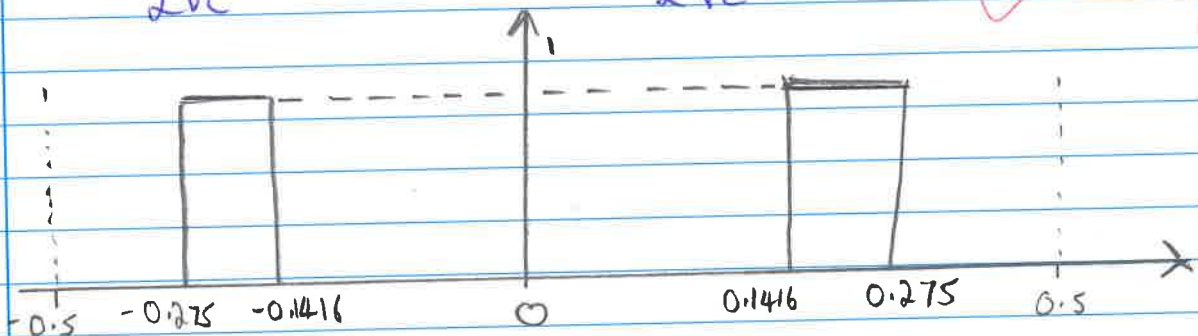
$$\alpha = 3$$

$$f_s = 12000 \text{ Hz}$$

$$\nu_e = \frac{f_e}{f_s} = \frac{1700}{12000} = 0.1416$$

$$\nu_u = \frac{f_u}{f_s} = \frac{3300}{12000} = 0.275 \quad (0.280)$$

$$\frac{\nu_u - \nu_e}{2\nu_c} = \frac{0.275 - 0.1416}{2\nu_c} = \nu_c = 0.0667$$



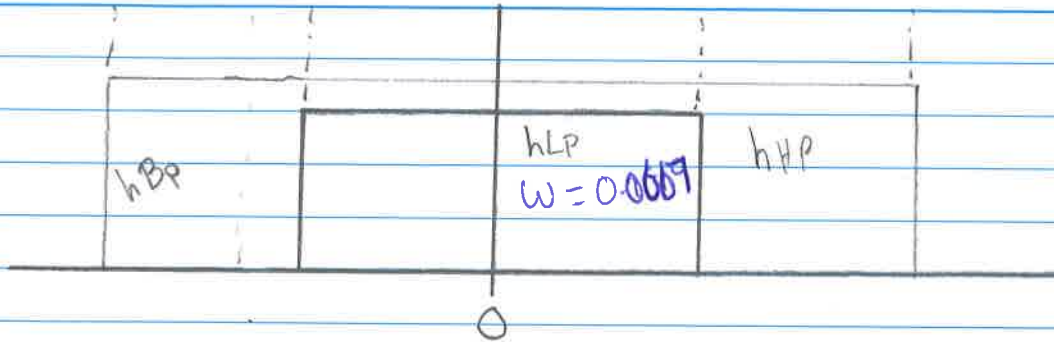
$$\nu_e + \nu_e = \nu_0$$

$$0.1416 + 0.1416 = 0.2832$$

$$h_{LP}(k) = \frac{1}{\pi(k-\alpha)} \times \sin(2\pi(k-\alpha) \times 0.0667)$$

$$h_{LP}(k) = \frac{1}{\pi(0-\alpha)} \times \sin(2\pi(0-\alpha) \times 0.0667)$$

$$\omega = 0.1009$$



K	hLP	hBP	hHP
0	0.0009 ✓	1.171	-0.0667
1	0.0188 ✓	-1.828	0.0667
2	0.1295 ✓	-0.414	-0.0667
3	0.0667 ✓	0.2832	0.0667
4	Switch	Switch ✓	Switch ✓
5	Reverse	Reverse	Reverse ?
6			This might be wrong?

(9)

$$hBP(k) = [2 \times \cos(2 \times \pi (\alpha - \alpha) \times r_0)]$$

$$hHP(k) = (-1)^{k-a} hLP$$

4c

$$w(k) = 0.54 + 0.46 \cos\left(\frac{2\pi(0-3)}{7}\right) = 0.12555$$

k	Hamming window
0	0.12555
1	0.4376
2	0.8268
3	1
4	Switch
5	Reverse ✓
6	

(2)

(18)

Rhif y Cwestiwn