

**Complete, fold and seal
(see note 2 below)**

SURNAME: _____

Thomas

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Examination Answer Books

12 Pages

Instructions to Candidates

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.**

1	Student Number	1503513/1.
2	Title of Examination Paper	DSP B Communications
3	Module Code	M2X8515.
4	Date and Time of Examination	10.05.19. 13:
5	Examination Venue	Hall
6	Seat Number	33
7	Number of Answer Books handed in	

[illegible]

24%

Channel. Source Code corruption.
message channel.

$$F = \frac{\omega}{2\pi}$$

$$C = \log_2 \left(1 + \frac{S}{N} \right)$$

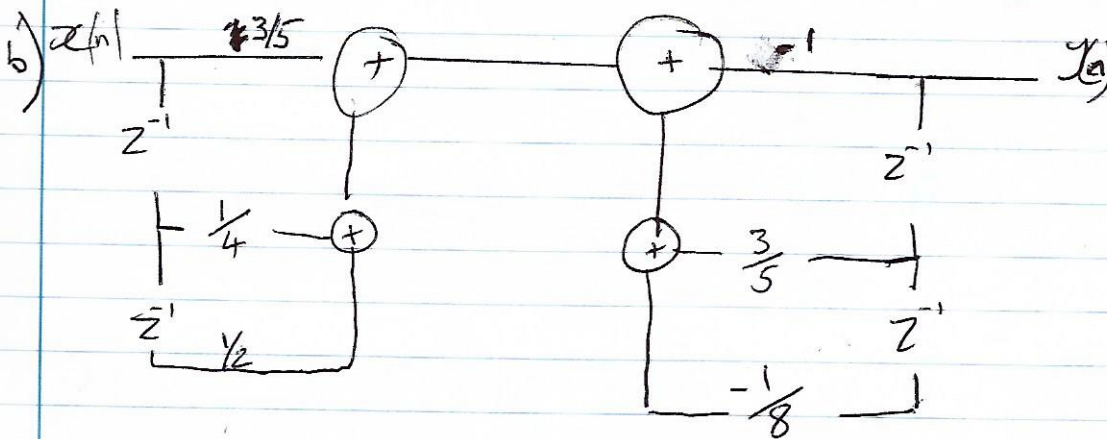
Q1

$$Yz - \frac{3}{5}Yz^{-1} + \frac{1}{8}Yz^{-2} = \frac{3}{5}Xz + \frac{1}{4}Xz^{-1} + \frac{1}{2}Xz^{-2}$$

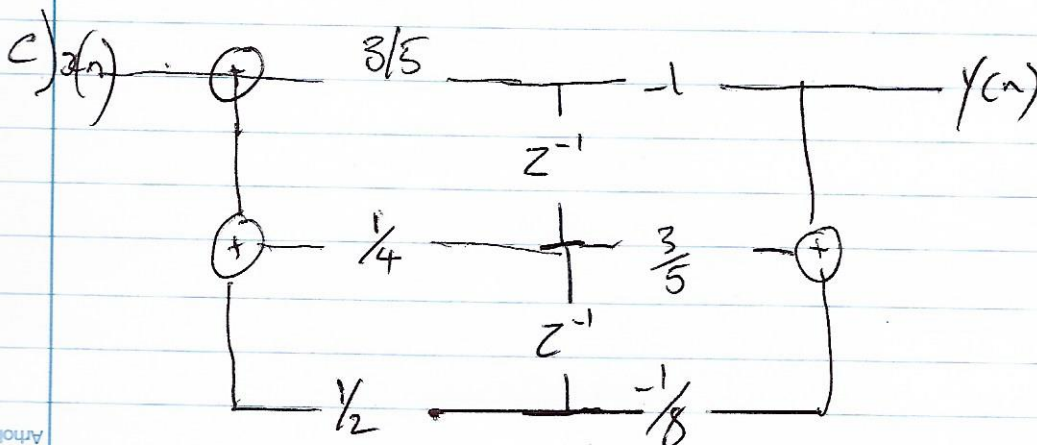
$$Yz \left(1 - \frac{3}{5}z^{-1} + \frac{1}{8}z^{-2} \right) = Xz \left(\frac{3}{5} + \frac{1}{4}z^{-1} + \frac{1}{2}z^{-2} \right)$$

$$\text{TF} \quad \frac{Yz}{Xz} = \frac{\frac{3}{5} + \frac{1}{4}z^{-1} + \frac{1}{2}z^{-2}}{1 - \frac{3}{5}z^{-1} + \frac{1}{8}z^{-2}}$$

3 ✓



3 ✓



✓

d). Direct form II uses less space / more efficient. ✓

e) more reliable. ✗

2). a) Channel Coding protects the Source Code from becoming Corrupt. ✓

Source Coding is a more efficient way of transmitting data. ✓

b). $\overline{1} \quad \overline{0} \quad \underline{1} \quad \underline{0} \quad \overline{1} \quad \underline{0} \quad \underline{0} \quad \overline{1} \quad \textcircled{0} \quad \underline{0} \quad \underline{1}$

$$1 = k \checkmark$$

$$2 = 1 \times$$

$$4 = 2 \checkmark$$

$$8 = 3 \times$$

$$2 + 8 = 10. \quad \underline{\underline{\text{error}}} \quad \checkmark$$

Correct Code =

1	0	1	0	1	0	0	1	1	1	0	1
---	---	---	---	---	---	---	---	---	---	---	---

c)

~~Stop down x/2.~~

w o n " " s l d
 3 3 2 2 1 1 1 ✓

$$w = 000 \quad \times 3 = 9$$

$$o = 001 \quad \times 3 = 9$$

$$n = 010 \quad \times 2 = 6$$

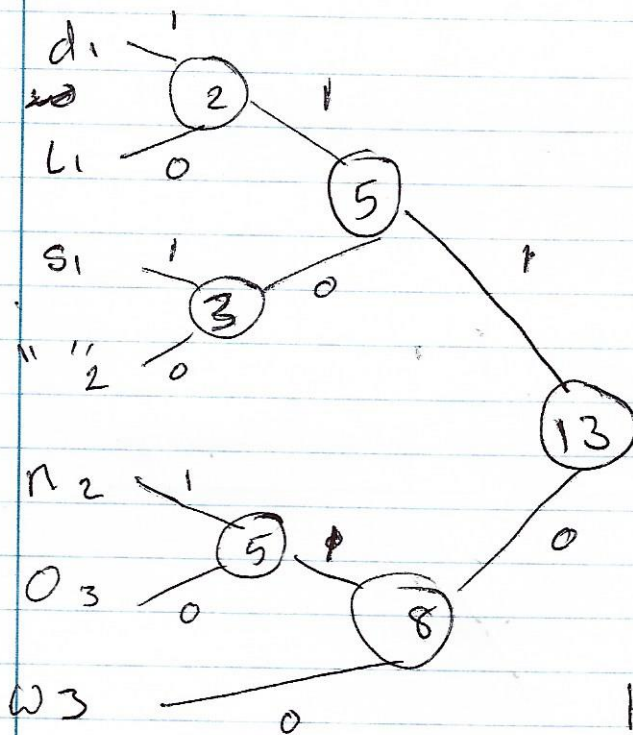
$$" = 100 \quad \times 2 = 6$$

$$s = 011 \quad \times 1 = 3$$

$$l = 101 \quad \times 1 = 3$$

$$d = 110 \quad \times 1 = 3$$

Total = 39 Bits. ✓

Huffman.

d = 111	x 1	3
L = 110	x 1	3
S = 101	x 1	3
" = 100	x 2	6
n = ~~001~~ 011	x 2	6
O = 010	x 3	9
w = 00	x 3	6
		= 36

36 Bits

Huffman Code has
 Saved 3 Bits of Data. ✓

Q3 $x(t) = 4\cos(4000\pi t) + 5\cos(10000\pi t) + 2\sin(6000\pi t)$.

~~Hz~~ $F = \frac{\omega}{2\pi}$ 2000 ✓ 5000 ✓ ~~6000~~ ³⁰⁰⁰ ✓

a) $= 5000 \times 2 = 10000$ s/s ✓
Nyquist = $\rightarrow$

b) $= 4\cos\left(\frac{2000}{4000}2\pi t\right) + 5\cos\left(\frac{5000}{4000}2\pi t\right) + 2\sin\left(\frac{3000}{4000}2\pi t\right)$
 $= 4\cos\left(\frac{2}{4}2\pi t\right) + 5\cos\left(\frac{5}{4}2\pi t\right) + 2\sin\left(\frac{3}{4}2\pi t\right)$

$\downarrow$
 $+ 5\cos\left(1 + \frac{1}{4}\right)2\pi t + 2\sin\left(1 - \frac{1}{4}\right)2\pi t$

DT = $4\cos\left(\frac{2}{4}2\pi t\right) + 5\cos\left(\frac{1}{4}2\pi t\right) + 2\sin\left(-\frac{1}{4}2\pi t\right)$

c) $4\cos\left(\frac{2}{4} \times 4000 \times 2\pi t\right) + 5\cos\left(\frac{1}{4} \times 4000 \times 2\pi t\right) + 2\sin\left(\frac{-1}{4} \times 4000 \times 2\pi t\right)$
 $x(t) = 4\cos(4000\pi t) + 5\cos(2000\pi t) + 2\sin(-2000\pi t)$

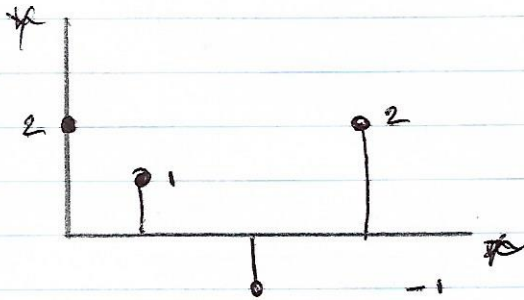
Both these signals are different from original because the signal was sampled below the Nyquist rate.

d).

Q4

$$h(n) = [2, 1, -1, 2]$$

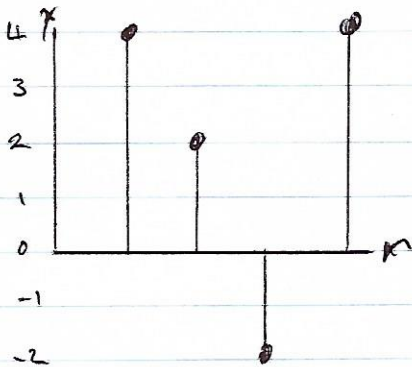
a)

b) $2h(n-1)$

$$2, 1, -1, 2$$

$$4, 2, -2, 4$$

$$0, 4, 2, -2, 4$$

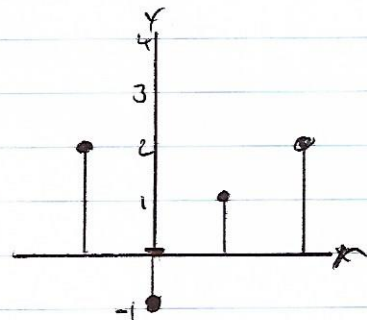


$$h(-n+2)$$

$$2, 1, -1, 2$$

$$2, -1, 1, 2$$

$$0, 0, 2, -1, 1, 2$$



$$c) \quad h(n) = [2, 1, -1, 2]$$

$$x(n) = [2, -1, 2, -1]$$

$h(n)x(n)$	4	2	-2	4			
$h(1)x(1)$	0	-2	-1	1	-2		
$h(2)x(2)$	0	0	4	2	-2	4	
$h(3)x(3)$	0	0	0	-2	-1	1	-2
	4	0	1	3	-5	5	-2

$$\text{Ans} = [4, 0, 1, 3, -5, 5, -2]$$

Q5 $T = 273 + 25 = 298$

$$20 \times 10^6$$

Noise z

$$1.38 \times 10^{-23} \times 298 = 4.1124 \times 10^{-21}$$

$$4.1124 \times 10^{-21} \times 20 \times 10^6 = \underline{8.2248 \times 10^{-14}}$$

$$C = b \log_2 \left(1 + \frac{S}{N} \right)$$