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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	1707513/1
2	Title of Examination Paper	DSP + Communications
3	Module Code	M2X8515 FOAC5000-003
4	Date and Time of Examination	10/05/14 1:36 - 3:36
5	Examination Venue	Hall
6	Seat Number	32
7	Number of Answer Books handed in	1

[illegible]

50%

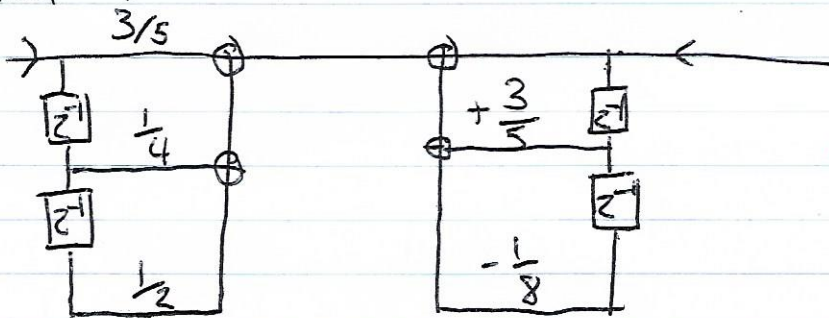
① a) $Y(z) - \frac{3}{5}Y(z)z^{-1} + \frac{1}{8}Y(z)z^{-2} = \frac{3}{5}X(z) + \frac{1}{4}X(z)z^{-1} + \frac{1}{2}X(z)z^{-2}$

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

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

2. ✓

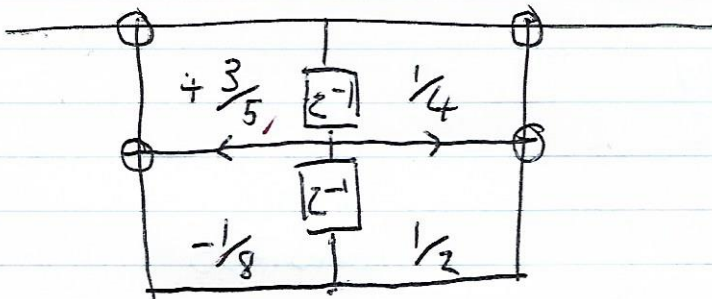
b) Direct form 1



✓

2. ✓

c) Direct form 2



✓

2. ✓

d) Direct form 2 uses less components than direct form 1, as it is simplified.

✓

e)

- ② ~~Channel coding - Protect source encrypt~~
~~Source coding - Simplify a message so less bits are used~~

a) Channel coding is done to protect the source message where as source coding is done to simplify a message into fewer bits.

b)

c) SLOW DOWN NOW

S L O W D N " "

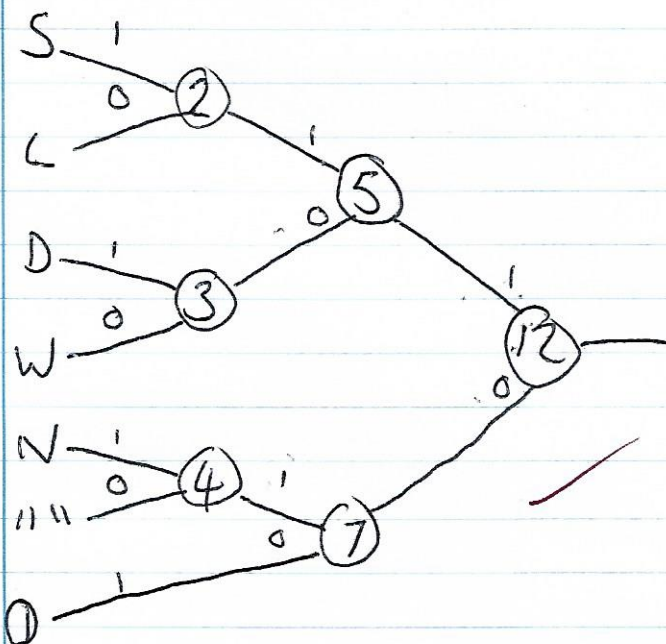
1 1 3 2 1 2 2

ascending order

S L D W N " " 0

1 1 1 2 2 2 3

$$12 \times 3 = 36$$



S 111
 L 110
 D 101
 W 100
 N 011
 " 010
 " 001

$$(3) \quad x(t) = 4 \cos(4000\pi t) + 5 \cos(10000\pi t) + 2 \sin(6000\pi t)$$

$$a) \quad f_{\text{Nyquist}} = 2f_{\text{max}}$$

$$f_1 = 2000 \quad \checkmark$$

$$f_2 = 5000 \quad \checkmark$$

$$f_3 = 3000 \quad \checkmark$$

$$f_{\text{max}} = 5000 \quad \checkmark$$

$$f_s > 2f_{\text{max}} = 10000 \text{ Hz} \quad \checkmark$$

$$f_N = 2f_{\text{max}} = 10000 \text{ Hz}$$

b) If signal sampled at 4000 Hz determine DT sig

$$= 4 \cos \left(\frac{4000}{5000} \pi t \right)$$

$$= 4 \cos \left(\frac{4000}{4000} \pi t \right) + 5 \cos \left(\frac{10000}{4000} \pi t \right) + 2 \sin \left(\frac{6000}{4000} \pi t \right)$$

$$= 4 \cos 2\pi \left(\frac{1}{4} \right) + 5 \cos 2\pi \left(\frac{5}{4} \right) + 2 \sin 2\pi \left(\frac{6}{4} \right)$$

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

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

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

$$c) \quad 4 \cos 2\pi + 2 \sin 2\pi \left(\frac{1}{4} \right)$$

$$\frac{1}{4} \times \pi \times 4000 = 1000\pi$$

$$4 \cos 2\pi + 2 \sin 2\pi (1000)$$

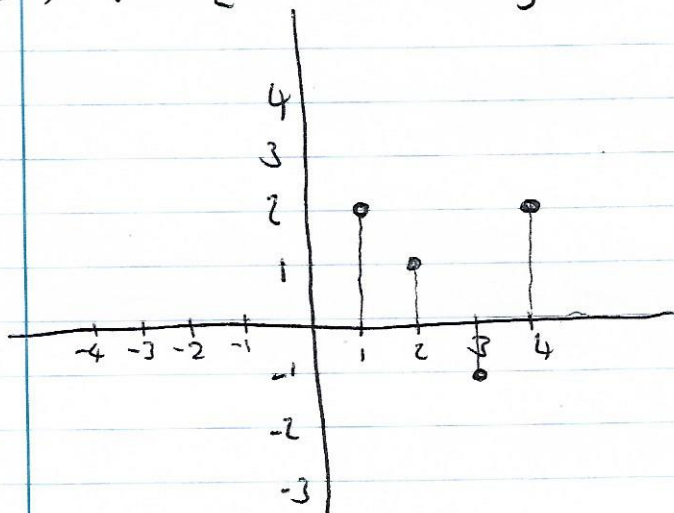
(potential recoverable analogue signal)

*)

The recoverable signal is far more simplified than the original, with only 2 terms.

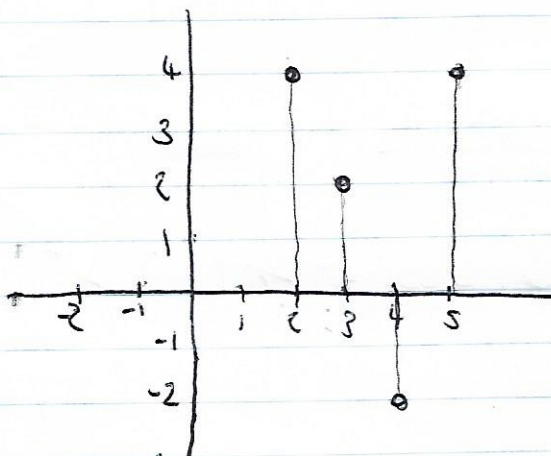
d) Shift key

④ a) $h(n) = [2, 1, -1, 2]$



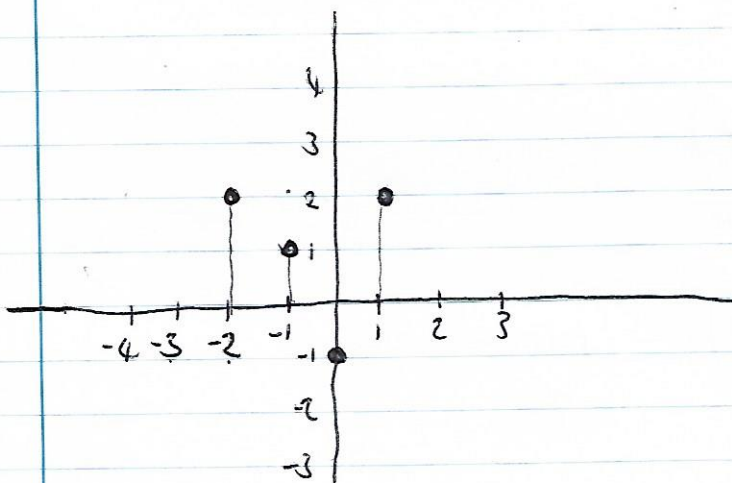
✓

b) $2h(n-1) = [4, 2, -2, 4]$



✓

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



✓

$$c) h(n) \begin{bmatrix} 2 & 1 & -1 & 2 \\ 2 & -1 & 2 & -1 \end{bmatrix}$$

~~$$\begin{bmatrix} 4 & 2 & -2 & 4 \\ -2 & -1 & 1 & -2 \end{bmatrix}$$~~

$$4 \quad 2 \quad -2 \quad 4$$

$$-2 \quad -1 \quad 1 \quad -2$$

$$4 \quad 2 \quad -2 \quad 4$$

$$-2 \quad -1 \quad 1 \quad -2$$

$$y_n = [8, 0, 4, 6, -5, 5, -2]$$

✓
✓
✓
✓

4 ✓

⑤ $f = 2437 \text{ MHz}$

$2427 \rightarrow 2447 \text{ MHz}$

$k = 1.58 \times 10^{-23}$

Temp = $25 + 273 = 298 \text{ kelvin}$

Initial transmit power $P_{TX} = 1 \text{ W}$

gain = 6 (6+30)

transmitted over 1 km

$FSPL = 20 \log_{10}(1) + 20 \log_{10}(2437) + 32.44$
 $= 100.1771$

* ~~$FSPL = 100.1771 \text{ dbm}$~~ ✓

~~$= -100.1771 \text{ dbm}$~~

$KTB = 1.38 \times 10^{-23} \times 298 \times 20 \times 10^6$ ✓

~~$= 8.2248 \times 10^{-14}$~~ ✓

~~$= 8.2248 \times 10^{-14} \text{ Mdb}$~~ ✓

convert $(30+6) - 100.1771 = -64.177$ ✓

~~$30 - 64.177 = 10 \log(\text{mW})$~~ / divide both sides by 10

$-6.4177 = \log(\text{mW})$ Take anti log

$10^{-6.4177} = (\text{mW}) = 3.822 \times 10^{-7} \text{ MW}$

~~$= 3.822 \times 10^{-7} \text{ MW}$~~

Shannon

$C = B \log_2 \left(1 + \frac{S}{N} \right)$ ✓ $\frac{S}{N} = \frac{3.822 \times 10^{-7}}{8.2248 \times 10^{-8}} = 4.6470$

~~$C = 20 \times 10^6 \log_2 \left(1 + \frac{3.822 \times 10^{-7}}{8.2248 \times 10^{-8}} \right)$~~ $C = 20 \times 10^6 \log_2 (1 + 4.647)$

$C = 511.479 \text{ M}$

~~$C = 44945850 \text{ bps}$~~