



Complete, fold and seal
(see note 2 below)

SURNAME: SHANNON

FORENAME(S): ANDREW

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	SHA09098546
2	Title of Examination Paper	Digital Signal Processing
3	Module Code	GOAC5000003 M2X8518
4	Date and Time of Examination	11 th May 2018 9:30
5	Examination Venue	68860
6	Seat Number	6
7	Number of Answer Books handed in	

[illegible]

(Gweler yr ochr arall am y fersiwn Cymraeg)

Template for Question 1 (Insert in Answer Booklet if used)

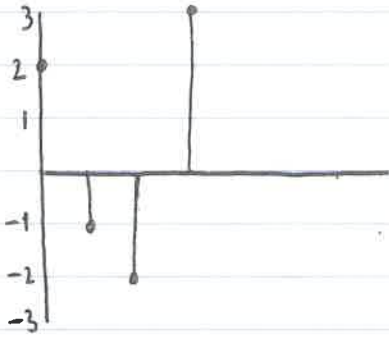
[illegible]

	0	1	2	3	4	5	6	7								
$h(n)$	2	-1	-2	3												
$x(n)$	2	-1	+2	-1												
	4	-2	-4	6												
	0	-2	1	2	-3											
	0	0	4	-2	-4	6										
	0	0	0	0	-2	1	2	-3								
$(hx)_n$	2	-2	4	-2												
$hx(n-1)$	0	-2	1	-2	1											
$hx(n-2)$	0	0	-4	2	4	2										
	0	0	0	6	-3	6	-3									
$y(n)$	4	-4	1	4	2	8	-3									

Student Name: A. Suman



1a)



✓

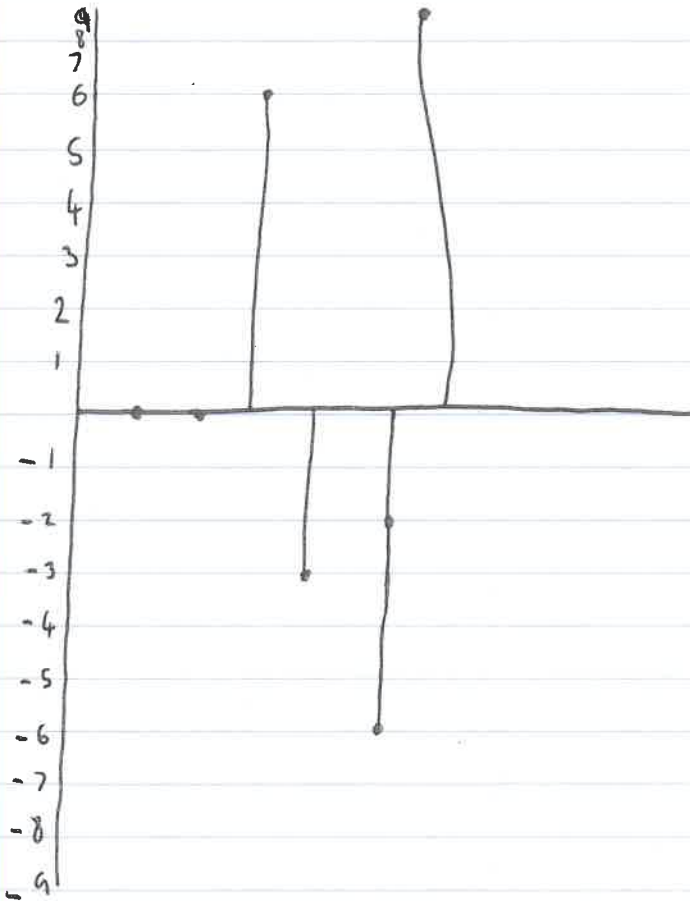
① ✓

b)

	0	1	2	3	4	5
$h(n)$	2	-1	-2	3		
$n-2$	0	0	2	-1	-2	3
$3h(n-2)$			6	-3	-6	9

✓

② ✓



c) $y[n] = 4 - 4 \quad 1 \quad 4 \quad 2 \quad 8 \quad -3$

(see added sheets)

⑤ ✓

4a) $x(t) = 3 \cos(2000\pi t) + 6 \cos(14000\pi t) - 4 \sin(4000\pi t)$

$$\frac{14000}{2} = 7000 \quad 7000 \times 2 = 14000$$

14000 Samples per second minimum

✓

③ ✓

b) $x(t) = 3 \cos \frac{2000}{6000} \pi t + 6 \cos \frac{14000}{6000} \pi t - \sin \frac{4000}{6000} \pi t$

① ✓

$$3 \cos \frac{1}{3} \pi t + 6 \cos \frac{7}{3} \pi t - \sin \frac{2}{3} \pi t$$

① ✓

$$3 \cos \frac{1}{3} \pi t + 6 \cos 2 \frac{1}{3} \pi t - \sin \frac{2}{3} \pi t$$

① ✓

$$9 \cos \frac{1}{3} \pi t - \sin \frac{2}{3} \pi t \quad \times 6000$$

$$\cancel{9 \cos 4000 \pi t - \sin}$$

$$9 \cos(2000 \pi t) - \sin(4000 \pi t)$$

② ✓

c) Sample ' $6 \cos(14000\pi t)$ ' has been removed after sampling

2



5)

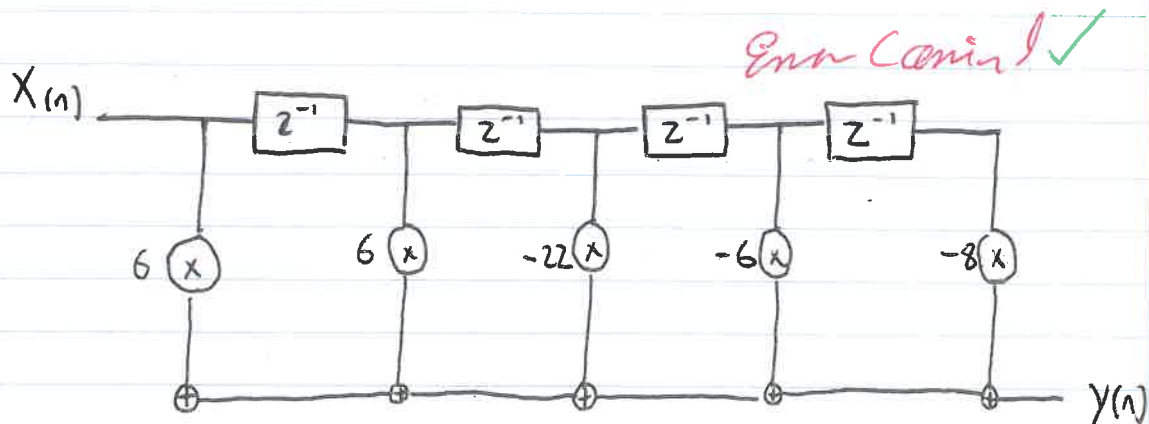
$$H(z) = (3 + z^{-2})(1 - 4z^{-1})(2 + 2z^{-1})$$

$$(3 - 12z^{-1} + z^{-2} - 4z^{-3})(2 + 2z^{-1})$$

$$6 + 6z^{-1} - 24z^{-2} + 2z^{-2} + 2z^{-3} - 8z^{-3} - 8z^{-4}$$

Missing Term ✓

$$6 + 6z^{-1} - 22z^{-2} - 6z^{-3} - 8z^{-4}$$



$$Y(n) = 2z^{-1} + 3z^{-2} + 2(2z^{-1} + 4z^{-2})$$

3

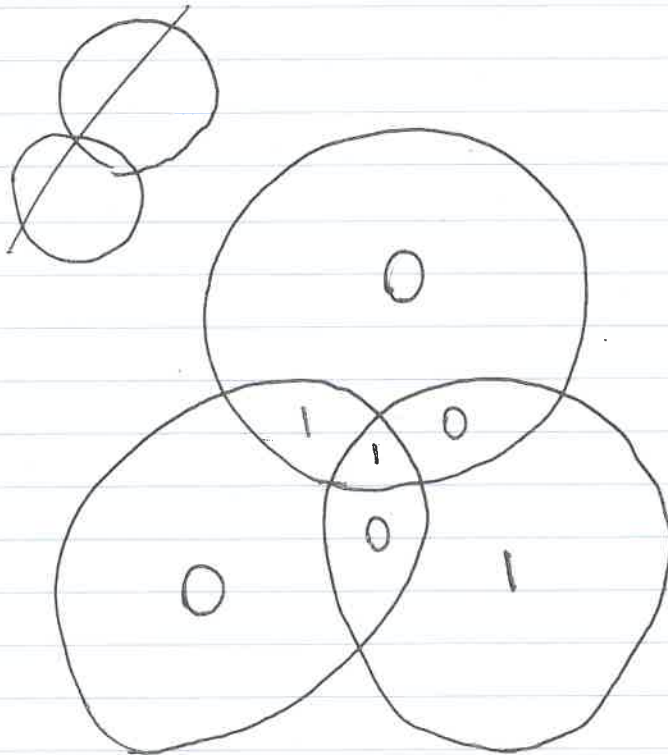
1 0 1 0 0 0 1 1 0 1 0 0 0 1

Wrong

X

1 0 1 0 0 0 1 1 0 1 0 0 0 0

b)



✓

3 ✓

b) 1 0 1 0 0 0 1

X

2

2a Hamming Low pass filter

$$\frac{\Delta F}{F_c} = \frac{3000}{40000} = 0.0075$$

$$d_p = \log^{-1} \frac{A_p}{20} =$$

$$A_p = 0.1$$

$$\log^{-1} \frac{0.1}{20} = 1.011$$

$$\Omega_c = 2\pi (F_p + 0.5\Delta F)$$

$$\Omega_c = 2\pi (10000 + \frac{1}{2}300)$$

$$\Omega_c = 2\pi (10000 + 150)$$

$$\Omega_c = 63774.3$$

$$\text{Low pass Filter} = 2F_c \frac{\sin \Omega_c}{n\Omega_c}$$

$$2F_c \frac{\sin 63774.33}{n\Omega_c 63774.33}$$

$$\text{Hamming } 0.54 - 0.46 \cos \left[\frac{2\pi n}{N-1} \right]$$

$$A_s = -20 \log d_s$$

$$d_s = \log^{-1} \frac{50}{20} = 316.2$$

$$A_s = -20 \log 316.2$$

$$A_s = -49.4$$