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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).
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1	Student Number	K12 23873625
2	Title of Examination Paper	QWTSO Digital Signature & Processing + Communication
3	Module Code	GOEE5003
4	Date and Time of Examination	22/5/25 1400
5	Examination Venue	Gower Centre Swansea
6	Seat Number	W3
7	Number of Answer Books handed in	1

Complete, fold and seal
(see note 2 below)

SURNAME:

KAZEM I

FORENAME(S):

ALEX

List the numbers of the questions you have attempted	Office Use
1	
2	
3	
4	
Q1	18 ✓
Q2	10 ✓
Q3	21 ✓
Q4	5 ✓
Total	54/100 ✓

54%

(Gweler yr ochr arall am y fersiwn Cymraeg)

$$1) a) y[n] = x[n] - 4$$

$$y_1[n] = x_1[n] - 4 \quad \checkmark$$

$$y_2[n] = x_2[n] - 4 \quad \checkmark \quad \underline{\underline{3}}$$

$$a_1 y_1[n] + b_2 y_2[n] = a_1 x_1[n] - 4 + b_2 x_2[n] - 4 \quad \checkmark \quad \times$$

$$\text{The system is } \{ a_1 x_1[n] - 4 + b_2 x_2[n] - 4 \}$$

$$a_1 x_1[n] - 4 + b_2 x_2[n] - 4 \quad \checkmark \quad \checkmark$$

The system is not linear as they are not equal.

Q1

18/25

Q

Q1a

3/6

$$b) y[n] = 2x[n-3]$$

$$y[n-k] = 2x[n-k-3] \quad \underline{\underline{6}}$$

$$y[k] = \{x[n-k]\} = 2x[n-k-3]$$

The system is time-invariant as they are equal.

Q1b

6/6

$$c) i) y[n] = 4x[n-1] - 3x[n-2] + 2y[n-1]$$

The system is causal as $y[n]$ is not affected by any future terms.

Q1c

6/6

$$ii) y[n] = 6x[n+2] - 7x[n] + y[n+1]$$

The system is not causal as $y[n]$ is directly affected by future terms $[n+1]$ and $[n+2]$.

Recursive - output depends on previous terms
non - sole term $[n]$.

d) $y[n] = -0.3[n-1] + 0.7x[n]$

$$y[n] = -\sum_{i=1}^N a_i y[n-i] + \sum_{j=0}^M b_j x[n-j]$$

Q3d3/7

i) Recursive as $y[n]$ depends on previous terms $[n-1]$.

ii) a_n and b_n

$$a_1 = -0.3 \quad b_0 = 0.7$$

$$a_0 = ?? \quad \underline{1}$$

iii) $x[n] = u[n] \quad y[-1] = 0$

$$x[0] =$$

$$x[1] =$$

$$x[2] =$$

$$x[3] =$$

$$x[4] =$$

$$?? \quad \underline{0}$$

$$2) a) x(t) = 8 \sin(2\pi \times 1000 \times \frac{1}{10000}) u(t)$$

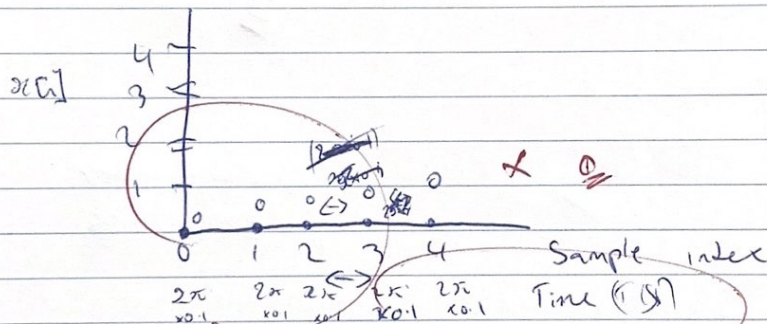
$$d) = 1 \quad x(t) = 8 \sin(2\pi \times 1000 \times \frac{1}{10000}) u(t)$$

$$x(t_s) = 8 \sin(2\pi \times 1000 \times \frac{1}{10000}) u(t_s)$$

$$x[n] = 8 \sin(2\pi \times 0.1) u[n]$$

$$ii) \quad \begin{aligned} x(0) &= 8 \sin(2\pi \times 0.1) (0) = 0 \\ x(1) &= 8 \sin(2\pi \times 0.1) (1) = 0 \\ x(2) &= 8 \sin(2\pi \times 0.1) (2) = 0 \\ x(3) &= 8 \sin(2\pi \times 0.1) (3) = 0 \\ x(4) &= 8 \sin(2\pi \times 0.1) (4) = 0 \end{aligned}$$

MULTIPLE OF SIN = 0



$$b) x[n] = \dots$$

$$x[n] = 5\delta[n-4] - 3\delta[n+2] + 2\delta[n] - 4\delta[n+1] + 3\delta[n-3] - 2\delta[n+5] + 1\delta[n-6]$$

$$3 + 4 - 1 = 6 \text{ marks}$$

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

$$i) x[n] = [1, 3, 0, 2]$$

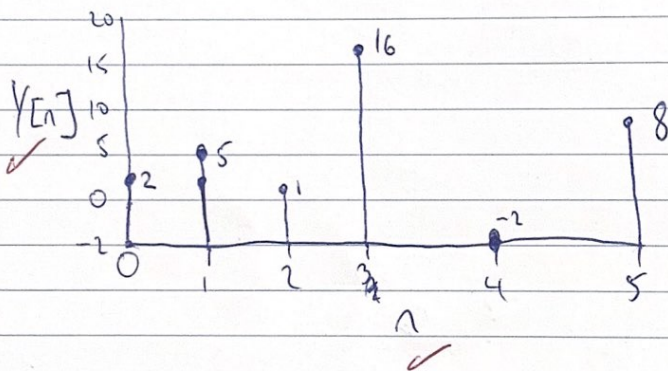
Q2c

n	0	1	2	3	4	5
$h[n]$	2	-1	4			
$x[n]$	1	3	0	2		
$x[0]h[n]$	2	-1	4			
$x[1]h[n-1]$	DELAY	6	-3	12		
$x[2]h[n-2]$	DELAY	DELAY	0	0	0	
$x[3]h[n-3]$	DELAY	DELAY	DELAY	4	-2	8
$y[n]$	2	5	1	16	-2	8

7/8

$$ii) y[n] = [2, 5, 1, 16, -2, 8]$$

4

USE smaller
tick marks

d) Nyquist sampling is $2 \times$ highest frequency

6000 Hz, 8000 Hz and 16000 Hz frequency components

Nyquist Sampling frequency is 3000 Hz.

Q2d

0/4

x0

(3) a) Line 12 $x(n) = (3^n) \cos(0.75\pi n) u(n)$

$$a^n \cos(bn) u(n) = \frac{Z[Z - a \cos(b)]}{Z^2 - [2a \cos(b)]Z + a^2}$$

$$X(z) = \frac{Z[Z - (3) \cos(0.75\pi)]}{Z^2 - [(2) \times (3) \cos(0.75\pi)]Z + (3)^2}$$

$$X(z) = \frac{Z[Z - 2.12]}{Z^2 - 4.24Z + 9}$$

Q321/25Q3a

b) $3y[n] - 2y[n-1] + y[n-2] = x[n] + 0.5x[n-1] - 0.5x[n-2]$ — 6/7

SPLIT

Z

$$3y[n] - 2y[n-1] + y[n-2] = x[n] + 0.5x[n-1] - 0.5x[n-2]$$

Factor

Transfer Function

$$3zY(z) - 2z^{-1}Y(z) + Y(z)z^{-2} = X(z) + 0.5z^{-1}X(z) - 0.5z^{-2}X(z)$$

$$(3z - 2z^{-1} + z^{-2})Y(z) = (1 + 0.5z^{-1} - 0.5z^{-2})X(z)$$

$$H(z) = \frac{Y(z)}{X(z)}$$

$$H(z) = \frac{(1 + 0.5z^{-1} - 0.5z^{-2})}{(3z - 2z^{-1} + z^{-2})}$$

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

Q3b5/8

SPLIT

Z

Factor

TRANSFER FUNCTION

$$c) y[n] + 0.5y[n-1] - 0.25y[n-2] = x[n] + 0.6x[n-1] - 0.4x[n-2]$$

$$y[n] + 0.5y[n-1] - 0.25y[n-2] = x[n] + 0.6x[n-1] - 0.4x[n-2]$$

$$Y(z) + 0.5z^{-1}Y(z) - 0.25z^{-2}Y(z) = X(z) + 0.6z^{-1}X(z) - 0.4z^{-2}X(z)$$

$$(1 + 0.5z^{-1} - 0.25z^{-2})Y(z) = (1 + 0.6z^{-1} - 0.4z^{-2})X(z)$$

$$H(z) = \frac{Y(z)}{X(z)}$$

$$H(z) = \frac{(1 + 0.6z^{-1} - 0.4z^{-2})}{(1 + 0.5z^{-1} - 0.25z^{-2})}$$

$$H(e^{j\omega}) = \frac{Y(\omega)}{X(\omega)}$$

$$H(e^{j\omega}) = \frac{(1 + 0.6e^{-j\omega} - 0.4e^{-2j\omega})}{(1 + 0.5e^{-j\omega} - 0.25e^{-2j\omega})}$$

Q3C

10/10

10

Q4 a)

7 Lap FIR BYPASS

Lower 800Hz

Upper 3000Hz

Sampling f_s 12000Hz

Examiner Only

Q45/25

$$h(k) = \begin{cases} \frac{\omega_H - \omega_L}{\pi} \\ \frac{\sin(\omega_H k)}{\pi k} - \frac{\sin(\omega_L k)}{\pi k} \end{cases} \quad \begin{matrix} k=0 \\ -M \leq k \leq M \end{matrix}$$

$$\omega = 2\pi f \quad \text{Lower cut off} = \frac{2\pi \times 800}{12000} = 0.41 \text{ rad/s}$$

$$\text{Upper cut off} = \frac{2\pi \times 3000}{12000} = 1.57 \text{ rad/s}$$

$$h(k) = \frac{\omega_H - \omega_L}{\pi} = 0.37$$

$$h(2) = \frac{\sin(1.57 \times 2)}{\pi \times 2} - \frac{\sin(0.41 \times 2)}{\pi \times 2} = 0.32 - 0.13 = 0.2$$

$$\text{Filter Length } L = 2M + 1$$

?

?

b) i) Multiplexing -

Q4b

2/15

ii) Analogue Modulation - Binary, consists only one signal is present

iii) ASK - Analogue Key Signal-Keying^{digital} Modulation
the presence of ^{digital} signal
Binary where only one ~~is~~ is monitored,
in ~~and~~ and monitors the absence of
the other signal.

iv) FSK - Frequency Signal-Keying^{digital} Modulation
Where ^{one} ~~the~~ Frequency^{term} (gain) is monitored.
(digital) and the other records absence
of the signal.

v) Baseband System - This is when a
~~transmission signal~~ is sent at a lower frequency than
signal ~~&~~ the original. Once reaching the receiver,
it is converted back to original frequency.