



CYFENW: Evans

ENW(AU) CYNTAF:

Dafydd John Llewelyn

Llyfr Atebion Arholiadau

12 Tudalen

Cyfarwyddiadau i Ymgeiswyr

1. Rhowch yr holl wybodaeth y gofynnir amdani yn y blychau isod.
2. Rhowch eich enw yn y lle a ddarparwyd ar y dde, plygwch ef a'i selio i lawr (gan ddefnyddio'r label a ddarparwyd) i guddio'ch enw.
3. Rhaid i'r atebion fod mewn llawysgrifen ddarllenadwy. Gall yr Arholwyr naill ai anwybyddu sgrïpt annarllenadwy, neu drefnu iddi gael ei theipio a chael yr ymgeisydd i dalu.
4. Ysgrifennwch eich atebion mewn inc.
5. Dechreuwch bob ateb ar dudalen newydd. Gwnewch unrhyw fras nodiadau yn y llyfr atebion a thynnu llinell drwyddynt.
6. Ni ddylid rhwygo unrhyw ran o'r llyfr hwn; rhaid ei gyflwyno yn gyfan.
7. Os defnyddir mwy nag un llyfr, rhwymwch hwy gyda'i gilydd gan ddefnyddio'r tagiau sydd ar gael oddi wrth y gwylwr/gwylwyr.
8. Rhaid dychwelyd pob llyfr. Ni chaniateir mynd â llyfrau atebion, wedi eu defnyddio neu heb eu defnyddio, allan o'r lleoliad arholi o dan unrhyw amgylchiadau.

1	Rhif Myfyriwr	EVA18843717
2	Teitl y Papur Arholiad	DSP and Communication
3	Cod y Modwl	GOEE 5003
4	Dyddiad ac Amser yr Archoliad	23/5/23 1:38
5	Lleoliad yr Arholiad	Ty Côch
6	Rhif Sedd	F2
7	Nifer y Llyfrau Atebion a gyflwynwyd	1

Rhestrwch rifau'r cwestiynau a ymgeisiwyd gennych	At Ddibenion y Swyddfa
1	
2	
3	
4	
Q1	12
Q2	9
Q3	30
Q4	21
	72/100
Cyfanswm	4

72%
G.M.

$$1) y[n] = x[2n] + 8$$

$$i) y(n) = H\{x(n)\} = x[2n] + 8$$

$$y_1(n) = H\{x_1(n)\} = x_1[2n] + 8 \quad \checkmark$$

$$y_2(n) = H\{x_2(n)\} = x_2[2n] + 8 \quad \checkmark$$

Q1

12/15

$$\text{Weighted} = a_1 x_1[2n] + a_2 x_2[2n] + 8(a_1 + a_2) \rightarrow ①$$

$$y_3(n) = H\{a_1 x_1(n) + a_2 x_2(n)\} = 2a_1 x_1 + 8a_1 + 2a_2 x_2 + 8a_2 \\ = 2a_1 x_1 + 2a_2 x_2 + 8(a_1 + a_2) \quad ② \quad \checkmark$$

① + ② are equal $\therefore$ linear $\checkmark$

ii) The system is non-causal as it doesn't depend on future inputs. e.g. $x(n+3)$ $\checkmark$

$$iii) y(n-k) = x[2(n-k)] + 8 \quad \text{Delay}$$

$$y(n-k) = x(2n-2k) + 8 \quad - ① \quad \checkmark$$

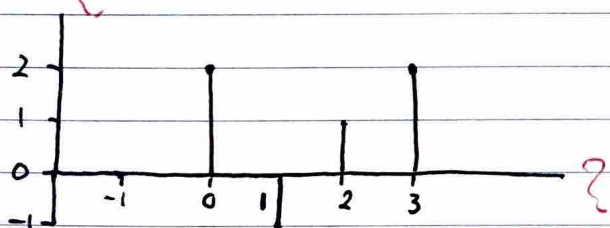
~~for k=2~~

$$y(n,k) = x(2n-k) + 8 \quad - ② \quad \checkmark$$

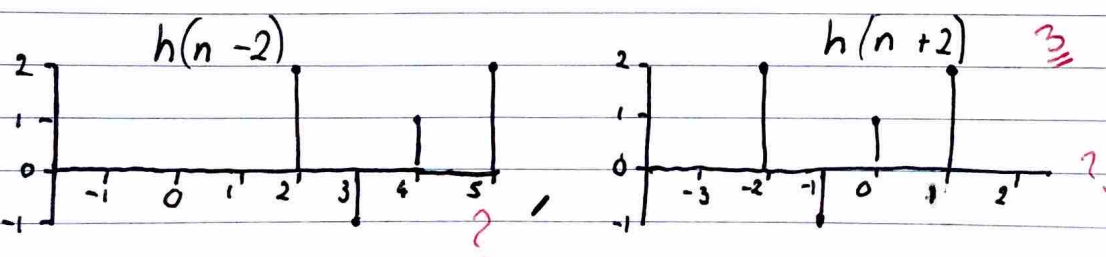
① + ② are not equal $\therefore$ Time variant. $\checkmark$

$$2) h[n] = [2, -1, 1, 2] \quad X[n] = [1, -2, 3, 2]$$

a)



b)



Q2

9/15

Q2a

1/2

Q2b

3/4

$D = \text{Delay}$

Rhif y Cwestiwn

Arholwr yn unig

c)

n	0	1	2	3	4	5	6	7
$h(n)$	2	-1	1	2				
$x(n)$	1	-2	3	2				
$x[0] h[n]$	2	-1	1	2				
$x[1] h[n-1]$	D	-4	2	-2	-4			
$x[2] h[n-2]$	D	D	6	-3	3	6		
$x[3] h[n-3]$	D	D	D	4	-2	2	4	
$x[4] h[n-4]$	D	D	D	D	4	-2	2	4
$Y(n)$	2	-5	9	1	1	6	6	4

$$\begin{aligned}
 Y(n) \text{ terms} &= h(n) + x(n) - 1 \quad \checkmark \\
 &= 4 + 4 - 1 \quad \checkmark \\
 &= 7 \quad \checkmark
 \end{aligned}$$

3)

a) $x(n) = 25 \sin(0.167 \pi n) u(n)$

$$\sin(an) u(n) = \frac{z \sin(a)}{z^2 - 2z \cos(a) + 1} \quad \checkmark$$

$$a = 0.167 \pi$$

$$X(z) = \frac{25z \sin(0.167 \pi)}{z^2 - 2z \cos(0.167 \pi) + 1} = \frac{12.5z}{z^2 - 1.731z + 1}$$

b) $y[n] + 1.2y[n-1] + 0.3y[n-2] - x[n-1] + x[n-3] = 0$

$$y[n] + 1.2y[n-1] + 0.3y[n-2] = x[n-1] - x[n-3]$$

$$\begin{aligned}
 Y(z) + 1.2z^{-1}Y(z) + 0.3z^{-2}Y(z) &= z^{-1}X(z) - z^{-3}X(z) \\
 Y(z) (1 + 1.2z^{-1} + 0.3z^{-2}) &= X(z) (z^{-1} - z^{-3}) \\
 \frac{Y(z)}{X(z)} &= \frac{z^{-1} - z^{-3}}{1 + 1.2z^{-1} + 0.3z^{-2}} = H(z)
 \end{aligned}$$

Q2

5/9

Q3
30/30

Q3a

6/6

Q3b

12/12

$$c) y[n] - \frac{1}{2}y[n-1] + \frac{1}{16}y[n-2] - x[n] = 0$$

$$Y(\omega) - \frac{1}{2}e^{-j\omega}Y(\omega) + \frac{1}{16}e^{-2j\omega}Y(\omega) - X(\omega) = 0$$

$$Y(\omega) - \frac{1}{2}e^{-j\omega}Y(\omega) + \frac{1}{16}e^{-2j\omega}Y(\omega) = X(\omega) \quad \checkmark$$

$$Y(\omega) \left(1 - \frac{1}{2}e^{-j\omega} + \frac{1}{16}e^{-2j\omega}\right) = X(\omega) \quad \checkmark$$

$$Y(\omega) = \frac{X(\omega)}{1 - \frac{1}{2}e^{-j\omega} + \frac{1}{16}e^{-2j\omega}} \quad \checkmark$$

$$\frac{Y(\omega)}{X(\omega)} = \frac{1}{1 - \frac{1}{2}e^{-j\omega} + \frac{1}{16}e^{-2j\omega}} = H(e^{j\omega}) \quad \checkmark$$

$$\frac{Y(\omega)}{X(\omega)} = \frac{1}{\left(1 - \frac{1}{4}e^{-j\omega}\right)^2} = H(e^{j\omega}) \quad \checkmark$$

4)
a) 3-tap FIR Low pass
cut off 1000 Hz, sampling 10,000 Hz

$$\text{Filter length} = 2M + 1 = 3$$

$$2M = 2$$

$$M = \frac{2}{2} = 1 \quad \checkmark$$

$$\omega_c = 2\pi f_c T_s \quad \checkmark$$

$$T_s = \frac{1}{f_s} \quad \checkmark$$

$$\omega_c = 2\pi \times \frac{f_c}{f_s} \quad \checkmark$$

$$\omega_c = 2\pi \times \frac{1000}{10000} = 0.2\pi \text{ radians.} \quad \checkmark$$

$$\text{Lowpass } h(k) = \begin{cases} \frac{\omega_c}{\pi} & k=0 \\ \frac{\sin(\omega_c k)}{\pi k} & -M \leq k \leq M \end{cases} \quad \checkmark$$

$$h(0) = \frac{\omega_c}{\pi} = \frac{0.2\pi}{\pi} = 0.2 \quad \checkmark$$

Q3C

12/12

Q4a

7/10

Q4

21/3

$$h(1) = \frac{\sin(\omega_c K)}{\pi K}$$

$$h(1) = \frac{\sin(0.2\pi \times 1)}{\pi \times 1} = \frac{0.5878}{\pi} \quad \times$$

using symmetry $h(-1) = h(1) = 0.5878/\pi$

Filter coefficients $b_k = h(k - M)$

$$b_k = h(0-1) = 0.5878/\pi$$

$$b_k = h(1-1) = 0.2 \quad \checkmark$$

$$b_k = h(2-1) = 0.5878/\pi$$

b) 5-tap bandpass filter

lower cut off = 1000 Hz

High cut off = 1250 Hz

Sampling frequency = 5000 Hz Q4b

Filter length $2M+1 = 5$

$$2M = 4$$

$$M = \frac{4}{2} = 2$$

$$\omega_L = 2\pi f_L T_s$$

$$T_s = \frac{1}{f_s}$$

$$\omega_L = 2\pi \times \frac{f_L}{f_s}$$

$$\omega_L = 2\pi \times \frac{1000}{5000} = 0.4\pi \text{ radians}$$

$$\omega_H = 2\pi \times \frac{f_H}{f_s}$$

$$\omega_H = 2\pi \times \frac{1250}{5000} = 0.5\pi \text{ radians}$$

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

$$\begin{aligned} h(0) &= \frac{\omega_H - \omega_L}{\pi} \\ &= \frac{0.5\pi - 0.4\pi}{\pi} = 0.1 \quad \checkmark \end{aligned}$$

$$\begin{aligned} h(1) &= \frac{\sin(\omega_H k)}{\pi k} - \frac{\sin(\omega_L k)}{\pi k} \\ &= \frac{\sin(0.5\pi)}{\pi} - \frac{\sin(0.4\pi)}{\pi} \\ &= 0.0156 \quad \checkmark \end{aligned}$$

Using symmetry $h(1) = h(-1) = 0.0156$ ✓

$$\begin{aligned} h(2) &= \frac{\sin(\omega_H k)}{\pi k} - \frac{\sin(\omega_L k)}{\pi k} \\ &= \frac{\sin(0.5\pi \times 2)}{2\pi} - \frac{\sin(0.4\pi \times 2)}{2\pi} \\ &= \frac{\sin(\pi)}{2\pi} - \frac{\sin(0.8\pi)}{2\pi} \\ &= -0.0935 \quad \checkmark \end{aligned}$$

using symmetry $h(-2) = h(2) = -0.0935$ ✓

Filter coefficients $b_k = h(k - M)$

$$b_k = h(0 - 2) = -0.0935$$

$$b_k = h(1 - 2) = 0.0156$$

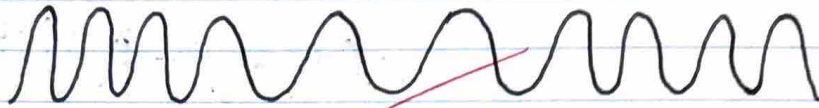
$$b_k = h(2 - 2) = 0.1 \quad \checkmark$$

$$b_k = h(3 - 2) = 0.0156$$

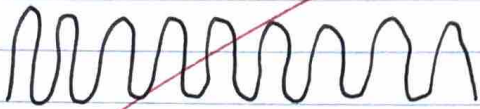
$$b_k = h(4 - 2) = -0.0935$$

Q4c02 ✓c)
i)

ii) Modulation and demodulation



AM



FM