



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, and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners cannot 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	2111407
2	Title of Examination Paper	Advanced Digital Signal processing
3	Module Code	ALDA6018
4	Date and Time of Examination	08/01/2025
5	Examination Venue	307
6	Seat Number	
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
1	-0-
2	-0-
3	13
4	03
Q1	0
Q2	0
Q3	13
Q4	3
Total	16/100

16
100
16/100

12-1
07/01/25

4. a. $y(n) = 1, 2, 3, 4, 4, 3, 2, 1$

(i) even $2, 4, 4, 2$
odd $1, 3, 3, 1$

even even $- 2, 4$

even odd $- 4, 2$

odd even $- 1, 3$

odd odd $- 3, 1$

(ii) $w_N^k = e^{-j \frac{2\pi}{N} k}$

$N = 8$

$w_8^1 = e^{-j \frac{2\pi}{8} 1} = 0.707 - j0.707$

$w_8^2 = e^{-j \frac{2\pi}{8} 2} = -j$

$w_8^3 = e^{-j \frac{2\pi}{8} 3} = -0.707 - j0.707$

$w_8^4 = e^{-j \frac{2\pi}{8} 4} = -1$

$Q_4 = 2 \times 1 = 2$

B.

Q3. SC $A = 3$ $f = 1200 \text{ Hz}$ $\phi = \frac{\pi}{6}$

LO $A = 2$ $f = 1150 \text{ Hz}$

SC $= 3 \cos((1200)t + \frac{\pi}{6})$

LO-phase $= 2 \cos((1150)t + \frac{\pi}{6})$

LOQ-phase $= 2 \sin((1150)t + \frac{\pi}{6})$

$I(t) = \text{SC} + \text{LO-phase}$

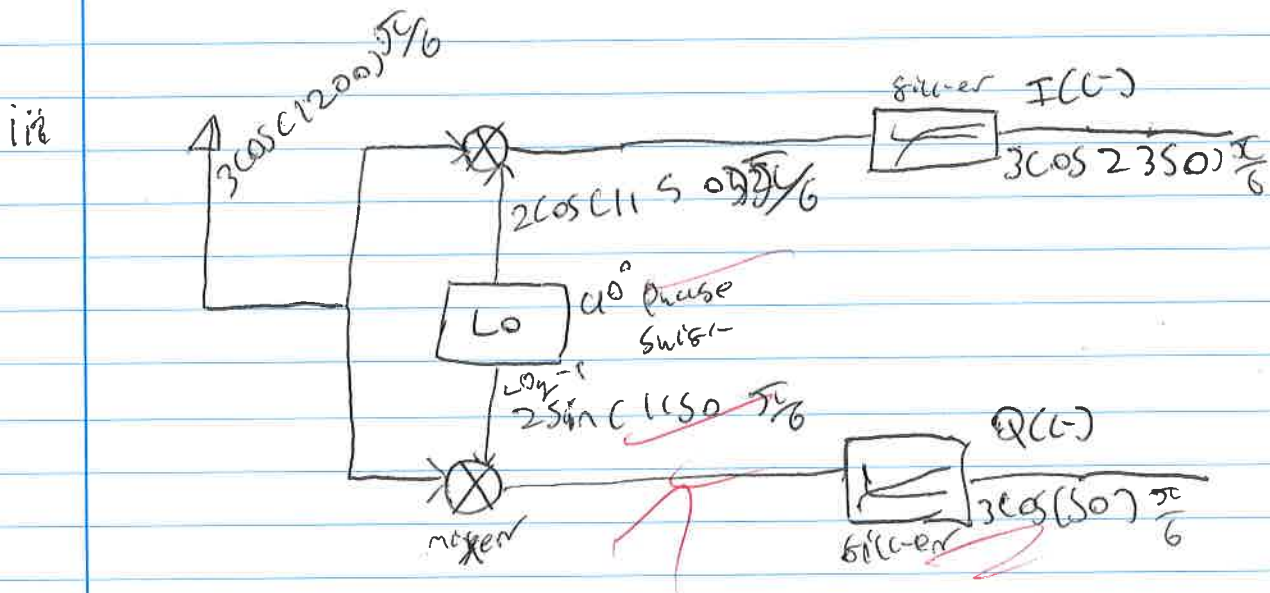
$I(t) = 3 \cos((2350)t + \frac{\pi}{6})$

$$Q(t) = S(t) - \cos \text{phase}$$

$$= \cos(150) \pi/6$$

$$Z(t) = I'(t) + jQ'(t)$$

$$Z(t) =$$



iii The RF input gets mixed with local oscillator signal twice ~~once~~ with the same phase and another with a 90° phase shift. It then gets filtered and ~~leaving~~ ~~the original signal~~.

Q.

i $1230 \text{ Hz} - 1150 \text{ Hz} = 80 \text{ Hz}$ would remain

ii The interference would cause a 30 Hz discrepancy. Original signal was at 50 Hz , new signal is at 80 Hz .

iii A cut-off frequency could be added at 55 to 60 Hz removing the 30 Hz difference above.

iii) better filter like a FIR filter could be added to remove/reduce line interference

4
0 $3.827648 - j3.27648j + j4.44448j - 0.444648$

$$2.829004 + 4.428 = 7.656004 - j7.1885464$$

$$+ 2.586j - 1.414 + 0.828j - 20.707 =$$

$$2.242 + 1.879j$$

$$0.707 - 0.828j$$

$$- 2.586 - j1.414 + 0.707 - 0.828j$$

$$3.295 - 1.879j +$$

$$- 1.879 + - 2.242$$

$$5.414 - 20.707$$

$$4.428 \times 0.707 - 0.707j = 3.41334 - 3.41334j$$

$$- j2.828 \times 0.707 - 0.707j = 1.494346j - 1.494346$$

$$1.413494 - j1.413494 \quad 5.412 - 20.707$$

$$3.227 + j2.121$$

$$- 6.82078$$

$$1.121 - j2.121$$

$$+ 4.13044$$

$$- j1.121 + 2.121 + - 2.242 - j0.707 = -j1.828 - 0.172$$

$$3.121 \times 0.707 - 0.707j = 2.207 - 2.207j$$

$$- j2.121 \times 0.707 - 0.707j = -j1.500 - j1.500$$

$$3.707$$

$$2.207 - 5.206j$$

$$3.707 \times 0.707 - 0.707j = 2.620 - 2.620j$$

$$- j0.707 \times 0.707 - 0.707j = 0.5j + -0.5$$

$$1.3 \times -0.707 \times 0.707 = -1.061$$

$$2.120 - 2.120j$$

$$j4.444 \times -0.707 \times 0.707 = -3.181$$

$$3.121 + 2.121j$$

$$5.141$$

2. $x(n) = \begin{cases} 1 & -1 \leq n \leq 1 \\ 0 & \text{elsewhere} \end{cases}$

$-1, 0, 1$

$X(N) = \frac{1}{N} \sum_{k=0}^{N-1} x(k) e^{j2\pi nk/N}$

$x(n) = \frac{1}{N} \sum_{k=0}^{N-1} X(k) e^{j2\pi nk/N}$

1.

3. $F(j\omega) = \frac{1}{\omega^2 + 1} e^{-2\omega^2}$ answer = a.

$\delta(t-2) e^{j\omega t}$

$\delta(t-t_0) \leftrightarrow e^{-j\omega t_0}$

$t_0 = 2$

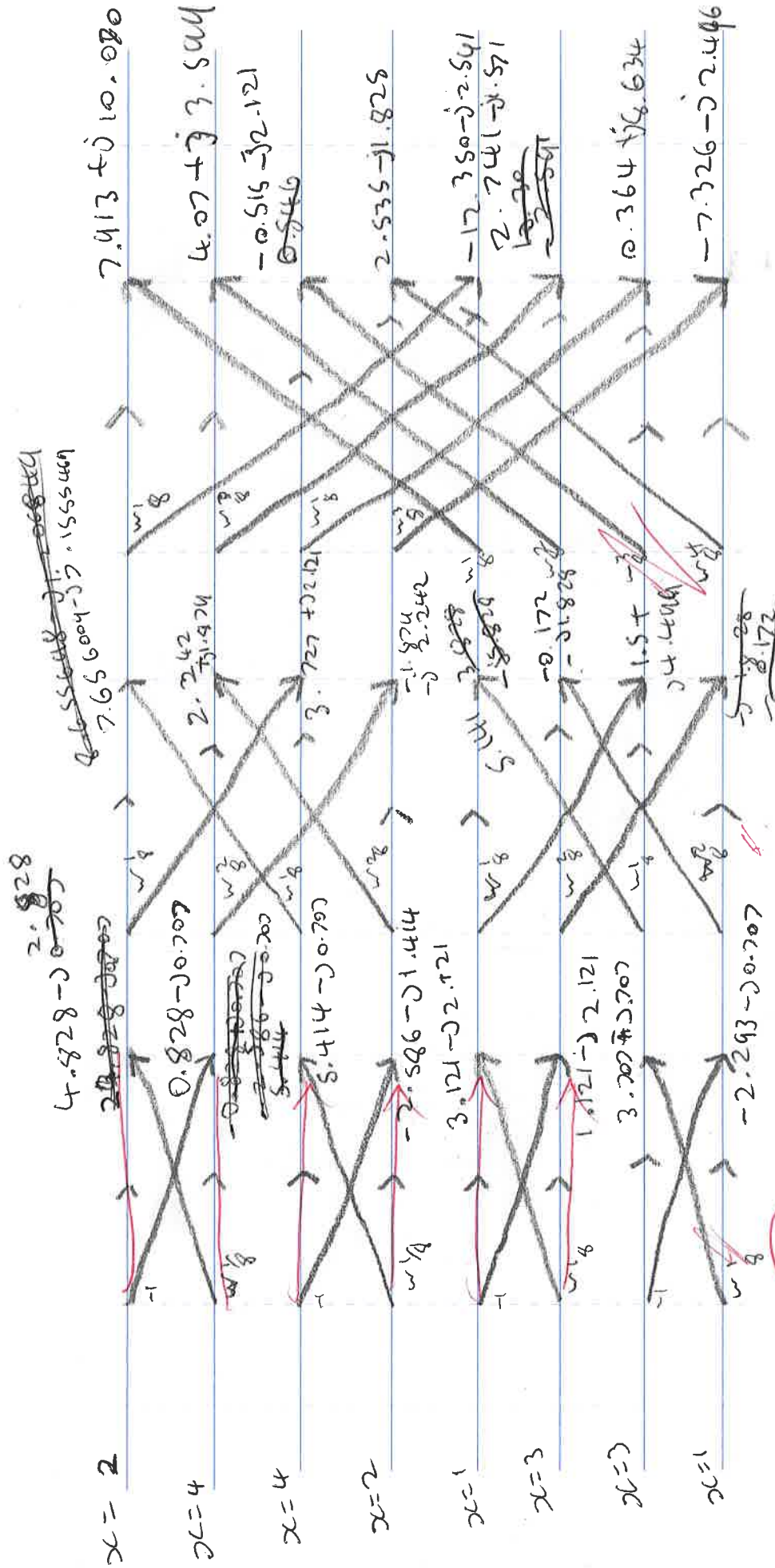
$2e^{-\omega^2}$

Q2

i. FIR systems

$2e^{-\omega^2}$

↑
↓



-4.414 + j 0.414

①