

2

12 Pages

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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 can either accept a handwritten script or have it typed and the expense of typing charged to the candidate.
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5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
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1	Student Number	2407080
2	Title of Examination Paper	SIGNALS & SYSTEMS
3	Module Code	ACDA4009
4	Date and Time of Examination	12/05/2025 9:00 AM.
5	Examination Venue	IQ 103.
6	Seat Number	# 1.
7	Number of Answer Books handed in	

[illegible]

(Gweler yr ochr arall am y fersiwn Cymraeg)

$$\frac{78}{100}$$

✓

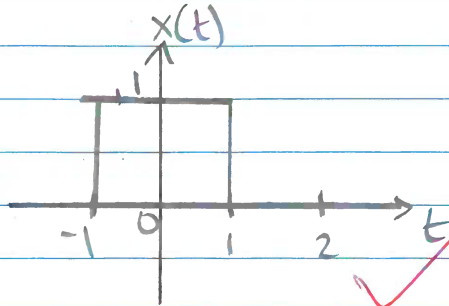
 $78/100$

①

$$a) \quad x(t) = \begin{cases} 1, & \text{if } |t| \leq 1 \\ 0, & \text{otherwise.} \end{cases}$$

i) CONTINUOUS TIME SIGNAL, UNIT STEP FUNCTION (RECTANGULAR). ✓

ii)



2

$$iii) \quad y(t) = x(2t+3).$$

~~$$@ -1 \quad t = -3 \quad y = x(2(-3)+3) = x(-3) = 0$$~~

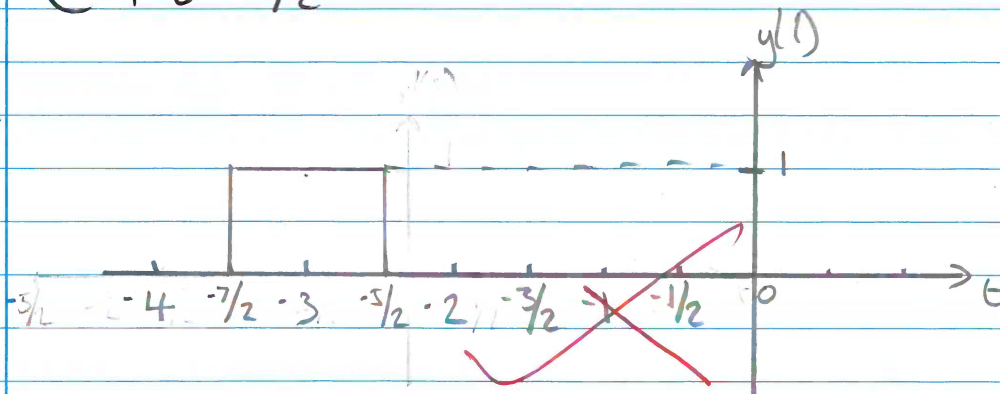
$$@ -1 = x(2t+3), \quad 2t+3 = -1$$

$$@ 0 \quad t = -3/2 =$$

$$@ 1 \quad t = -5/2$$

$$@ -1 \quad t = -7/2$$

iv)



①

b) THE TIMING SHIFT HAS 'SLOWED' THE SIGNAL BY 3 AND AMPLIFIED BY 2. ✓

①

5/5
24

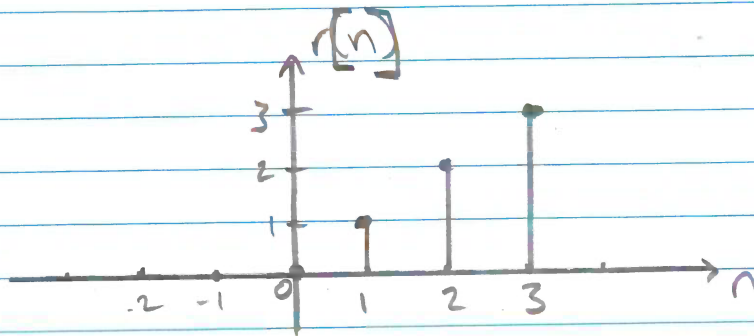
②

a)
i)

$$r[n] = \begin{cases} n, & \text{if } 0 \leq n \leq 3 \\ 0, & \text{if } n = 0 \end{cases}$$

DISCRETE TIME SIGNAL
UNIT RAMP FUNCTION.

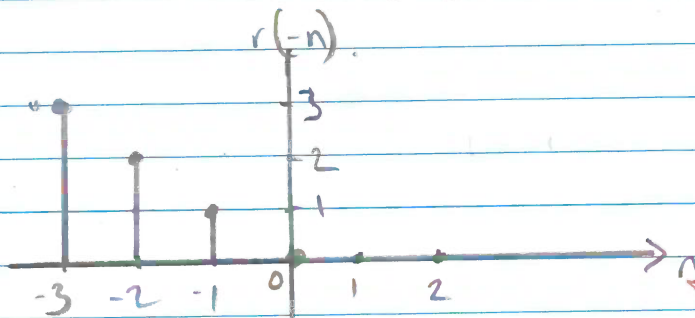
ii)



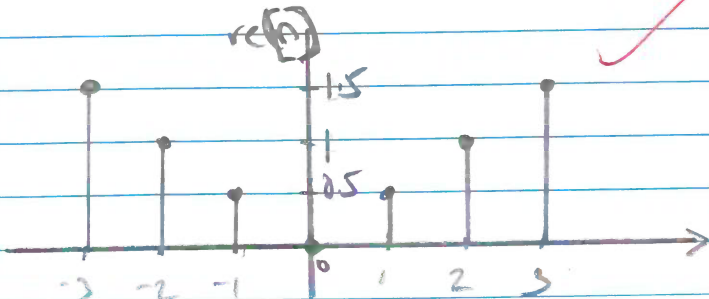
iii)

$$r_e[n] = \frac{1}{2}(r[n] + r[-n]) \quad + \quad r_o[n] = \frac{1}{2}(r[n] - r[-n])$$

so we need $r[-n]$.

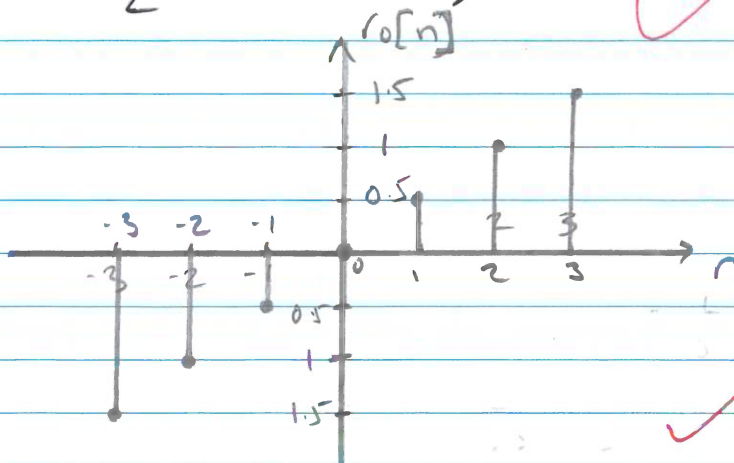


$$r_e[n] = \frac{1}{2}(r[n] + r[-n])$$

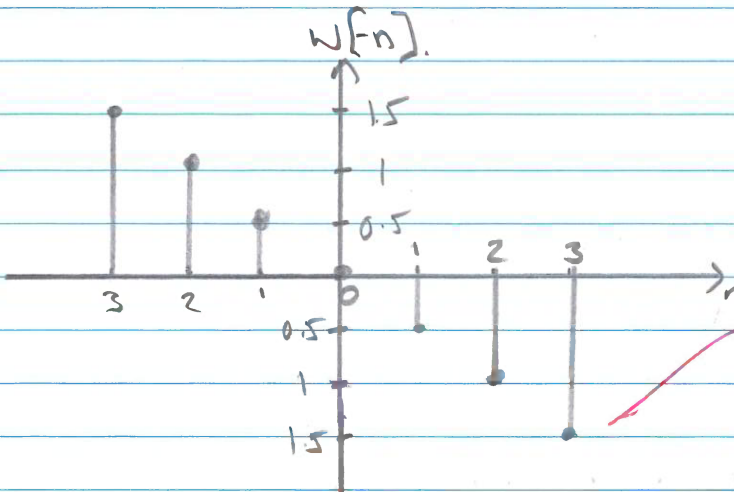




$$r_0[n] = \frac{1}{2}(r[n] - r[-n]).$$

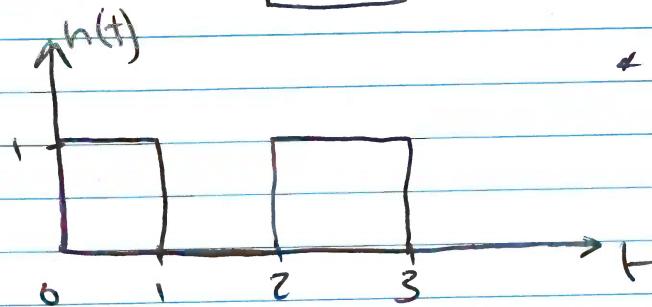
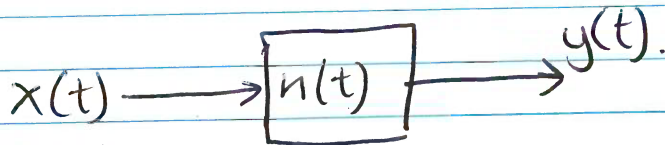


iv) if $w[n] = r_0[n]$, find $w[-n]$.



③

a)



$$x(t) = u(t)$$

$$i) \quad h(t) = \begin{cases} 1, & \text{for } 0 \leq t < 1 \\ 0, & \text{for } 1 \leq t < 2 \\ 1, & \text{for } 2 \leq t < 3 \\ 0, & \text{otherwise.} \end{cases}$$

$$ii) \quad y(t) = x(t) * h(t).$$

$$y(t) = \int_{-\infty}^{\infty} x(t) \cdot h(t) \cdot d(t)$$

$$iii) \quad \text{using } x(t) = u(t) \text{ which is also } x(z)$$

we can write.

$$\alpha = t - z \quad (2)$$

$$d\alpha = 0 - dz \quad (3)$$

$$y(t) = x(t) \text{ is a dummy } \underline{x(t) = 1}$$

$$\text{so, } y(t) = \int_{-\infty}^{\infty} 1 \cdot h(t) \cdot d(t)$$

$$\text{sub in } y(t) = \int_{-\infty}^{\infty} h(t-z) \cdot dz \quad (1)$$

iv).

$$y(t) = \int_{-\infty}^{\infty} h(t-z) \cdot dz \quad (1)$$

$$\text{using } x = t - z \quad (2)$$

$$dx = 0 - dz \quad (3)$$

$$y(t) = \int_{-\infty}^{\infty} h(x) \cdot d(-x) \quad (4)$$

now we use figure 1(b) for the limits
0, t.

$$\begin{array}{l} 0, \quad (2) \quad x = t - z = x = t - 0 = x = t \quad 1^{st} \\ t, \quad (3) \quad x = t - z = x = t - t = x = 0 \quad 2^{nd} \end{array}$$

$$y(t) = \int_t^0 h(x) \cdot d(-x)$$

limits are $0 \rightarrow t$. so we flip

$$y(t) = \int_0^t h(x) \cdot d(-x)$$

$$y(t) = \int_0^t h(x) \cdot d(x) \quad (5)$$

1st case.

1, for $0 \leq t < 1$

$$y(t) = \int_0^t h(x) \cdot d(x)$$

$$y(t) = \int_0^t 1 \cdot d(x)$$

$$= \int_0^t d(x) = [x]_0^t = [t - 0] = t$$

$$y(t) = t$$

2nd case 0, for $1 \leq t < 2$

$$y(t) = \int_0^1 h(x) \cdot d(x) + \int_1^t h(x) \cdot d(x)$$

$$= \int_0^1 1 \cdot d(x) + \int_1^t 0 \cdot d(x)$$

$$= \int_0^1 d(x) + 0$$

$$= [x] = [1 - 0]$$

$$\underline{y(t) = 1}$$

3rd case 1, for $2 \leq t \leq 3$

$$y(t) = \int_0^1 h(x) \cdot d(x) + \int_1^2 h(x) \cdot d(x) + \int_2^t h(x) \cdot d(x)$$

$$= \int_0^1 1 \cdot d(x) + \int_1^2 0 \cdot d(x) + \int_2^t 1 \cdot d(x)$$

$$= \int_0^1 d(x) + 0 + \int_2^t d(x)$$

$$= [x]_0^1 + [x]_2^t$$

$$= [1 - 0] + [t - 2]$$

$$1 + t - 2$$

$$\underline{y(t) = t - 1}$$

4th case $t \geq 3$

$$y(t) = \int_0^1 h(x) d(x) + \int_1^2 h(x) \cdot d(x) + \int_2^3 h(x) d(x)$$

$$= \int_0^1 1 \cdot d(x) + \int_1^2 0 \cdot d(x) + \int_2^3 1 \cdot d(x)$$

$$= \int_0^1 d(x) + 0 + \int_2^3 d(x)$$

$$= [x]_0^1 + \cancel{[x]_1^2} + [x]_2^3$$

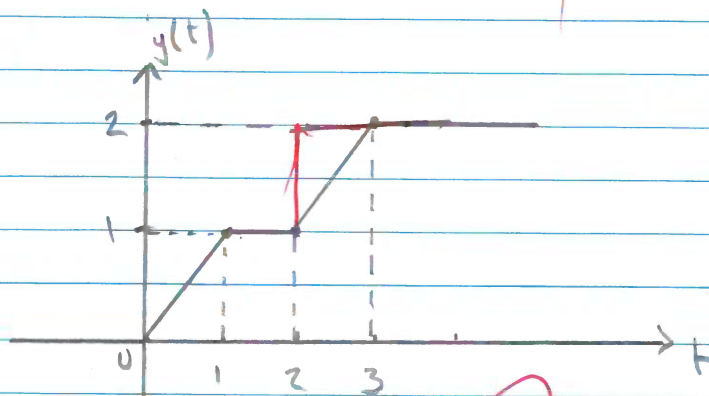
$$= [1 - 0] + [3 - 2]$$

$$1 + 1$$

$$\underline{\underline{y(t) = 2}}$$

v) $y(t) = \begin{cases} t, & 0 \leq t < 1 \\ 1, & 1 \leq t < 2 \\ t-1, & 2 \leq t < 3 \\ 2, & t \geq 3 \\ 0, & \text{for } t < 0 \end{cases}$

v.)



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2

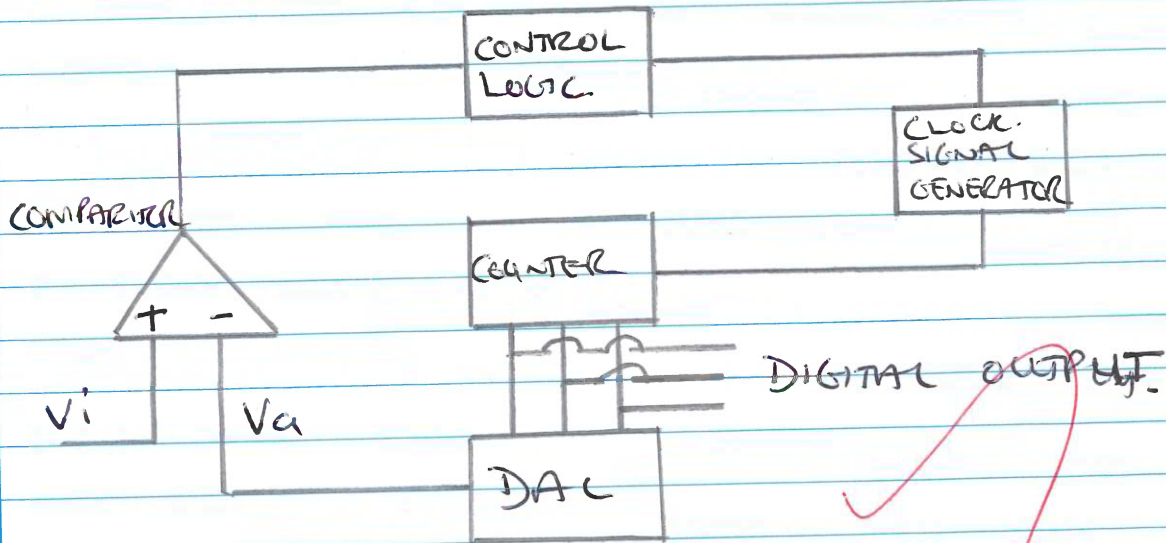
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2

(4)

a) COUNTER TYPE ADC

i)



ii) - COMPARETOR

- CONTROL LOGIC

- CLOCK SIGNAL GENERATOR

- COUNTER

- DIGITAL TO ANALOGUE CONVERTER (DAC).

iii) - OUTPUT OF THE COMPARETOR IS AT LOGIC '1' WHEN $V_i > V_a$

- CONTROL LOGIC RECEIVES '1' FROM COMPARETOR IT INITIATES THE CLOCK SIGNAL GENERATOR COUNTER WILL START COUNTING.

- DAC CONVERTS DIGITAL SIGNAL TO ANALOGUE VOLTAGE V_a + COMPARETOR COMPARES V_i WITH V_a .- IF $V_a > V_i$ ($V_i < V_a$) OUTPUT OF COMPARETOR IS LOGIC '0'.

- WHEN CONTROL LOGIC RECEIVES '0' FROM COMPARETOR, IT STOPS THE CLOCK SIGNAL GENERATOR, PROCESS IS STOPPED + DIGITAL OUTPUT IS DISPLAYED.

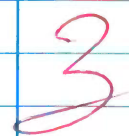
4

8 4 2 1

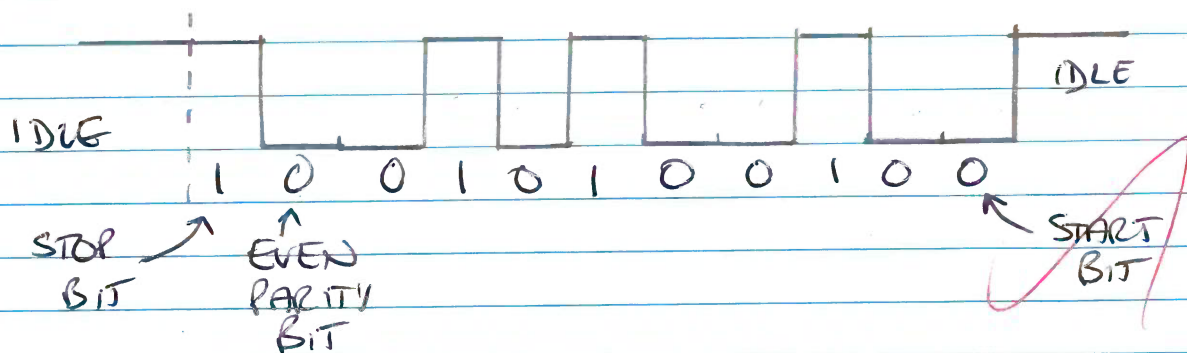
Binary

 $A = 10$
$$B = 11$$
$$C = 12$$
$$D = 13$$
$$E = 14$$
$$F = 15$$
$$I = 49 = \underbrace{0100}_4 \underbrace{1001}_9$$
$$N = 4E = \underbrace{0100}_4 \quad \underbrace{1110}_{E(14)}$$
$$T = 54 = \underbrace{0101}_5 \quad \underbrace{0100}_4$$

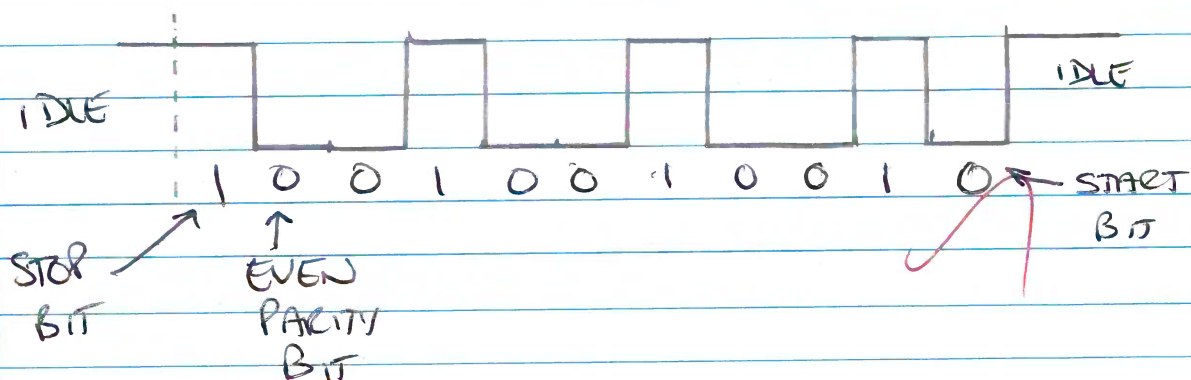
$P = 0101 \ 0000$



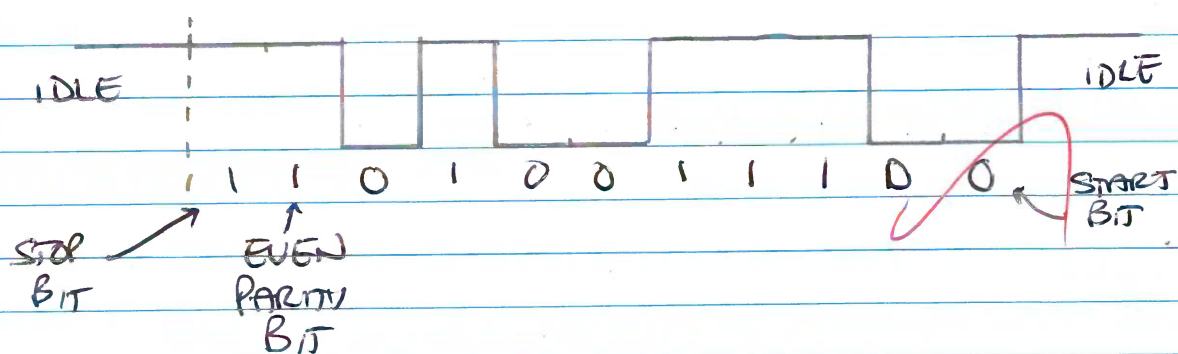
R = 0101 0010



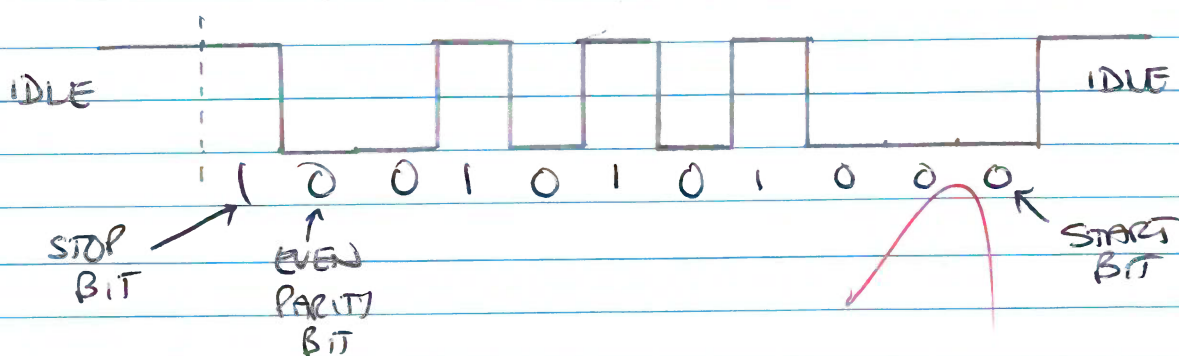
I = 0100 1001



N = 0100 1110



T = 0101 0100
~~0000~~





Question No.

Examiner Only

