

d the function

Instructions to Candidates

1. Please give the information requested in the box
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	2400571
2	Title of Examination Paper	SIGNALS AND SYSTEMS
3	Module Code	ACDA4009
4	Date and Time of Examination	12/05/2025 9:00 - 11:00
5	Examination Venue	IQ Building IQ 403
6	Seat Number	12
7	Number of Answer Books handed in	1

[illegible]

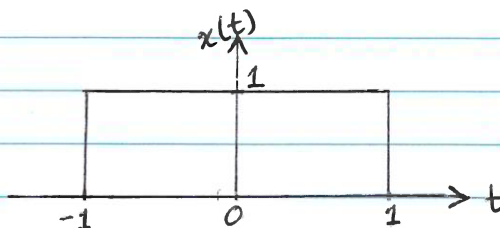
$\frac{82}{100}$

PL 1

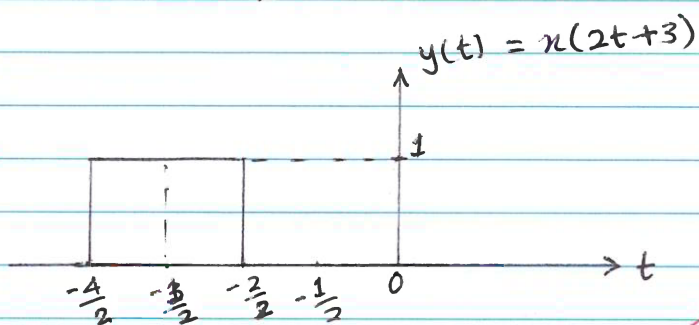
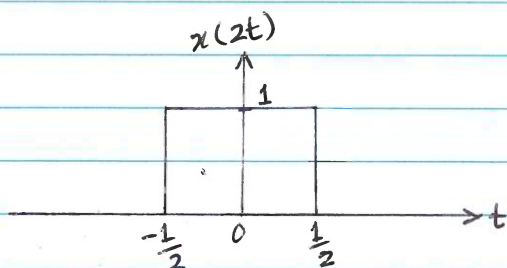
(1a)

i) This is a continuous time signal, and the function is a unit rectangular function

ii)

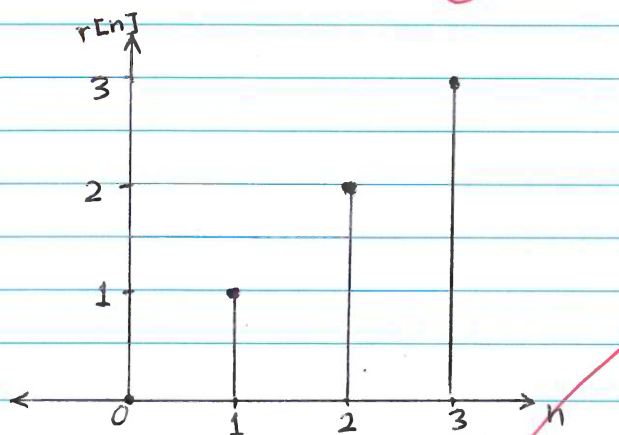


iii)

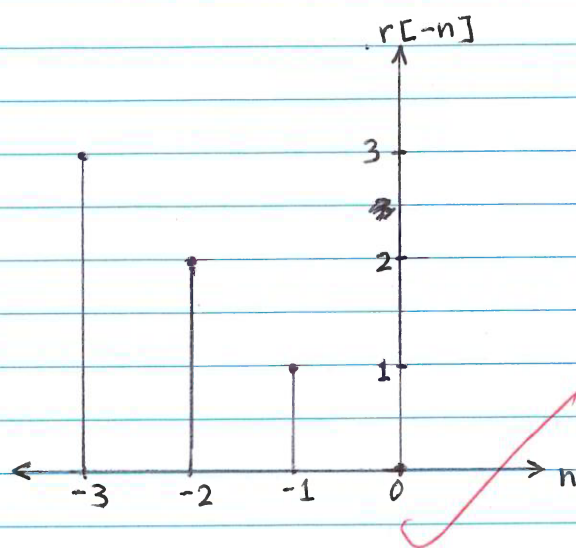


(2a) i) This is a discrete time signal, and the function is a unit ramp function

ii)



iii)



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

when $n[3]$, 1.5

$n[2]$, 1

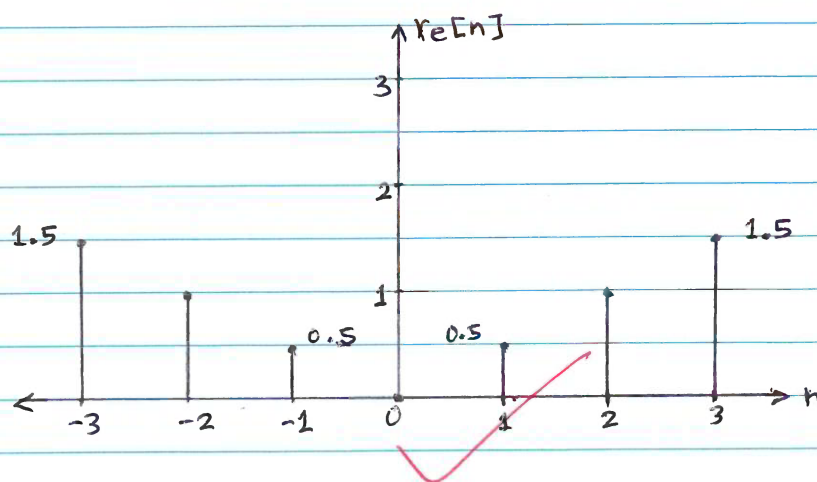
$n[1]$, 0.5

$n[0]$, 0

when $n[-3]$, 1.5

$n[-2]$, 1

$n[-1]$, 0.5



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

when $n[3], 1.5$

$n[2], 1$

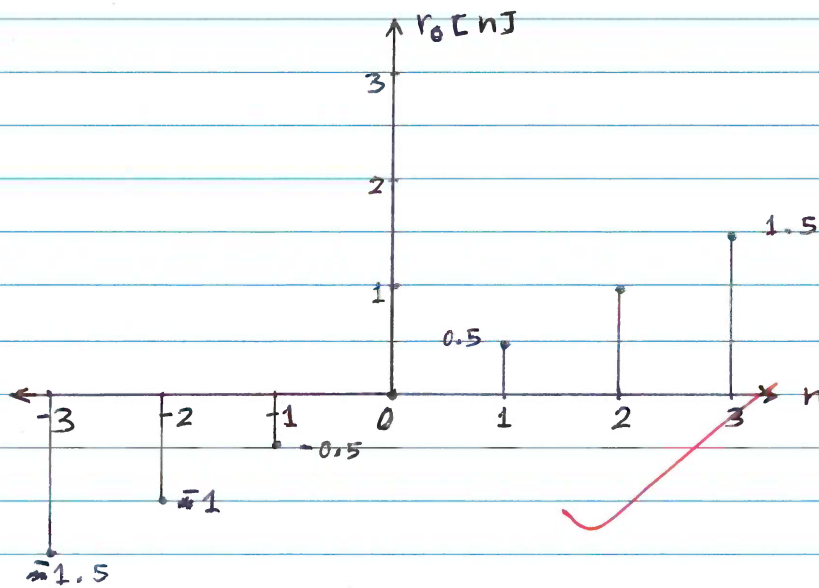
$n[1], 0.5$

$n[0], 0$

$n[-3], -1.5$

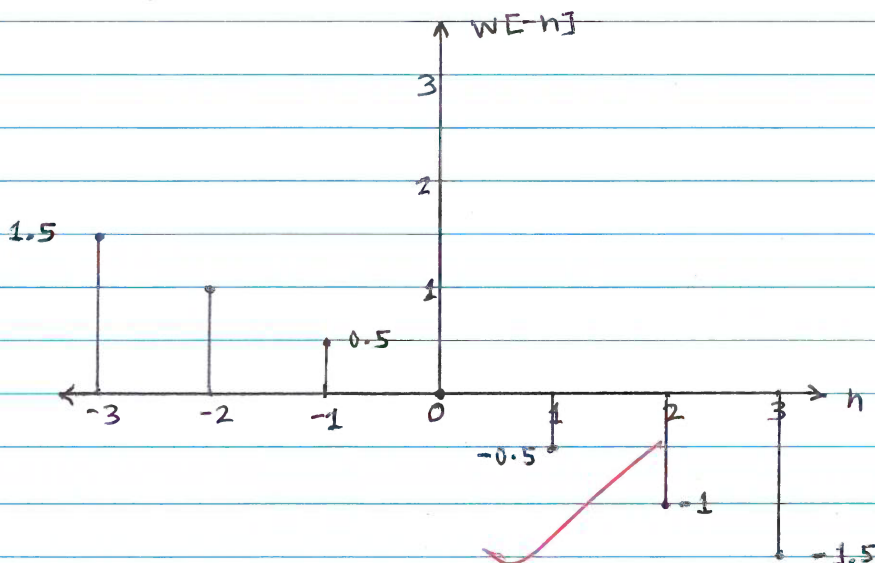
$n[-2], -1$

$n[-1], -0.5$



iv) Since $w[n] = r_0[n]$

$$w[-n] = r_0[-n]$$



(3a) i)

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

ii)

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

iii)

$$x(t) = u(t) = 1$$

$x(t)$ is also equal to $x(z)$

$$\therefore x(t) = u(t) = x(z) = 1$$

hence, $y(t) = \int_{-\infty}^{\infty} h(t-z) dz$

iv) Substituting all the mathematical intervals in the following equation:

$$y(t) = \int_0^t h(\alpha) d\alpha$$

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

$$y(t) = \int_0^t (1) d\alpha = [\alpha]_0^t = t - 0$$

$$y(t) = t$$

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

$$y(t) = \int_0^1 (1) d\alpha + \int_1^t (0) d\alpha = [\alpha]_0^1 + [0]$$

$$y(t) = 1 - 0 = 1$$

case 3, for $2 \leq t < 3$

$$y(t) = \int_0^1 (1) d\alpha + \int_1^2 (0) d\alpha + \int_2^t (1) d\alpha$$

$$y(t) = \int_0^1 [1]_0^1 + \int_1^2 [0] + \int_2^t [1]_2^t$$

$$y(t) = 1 + t - 2 = t - 1$$

case 4, for $t \geq 3$

$$y(t) = \int_0^1 (1) d\alpha + \int_1^2 (0) d\alpha + \int_2^3 (1) d\alpha$$

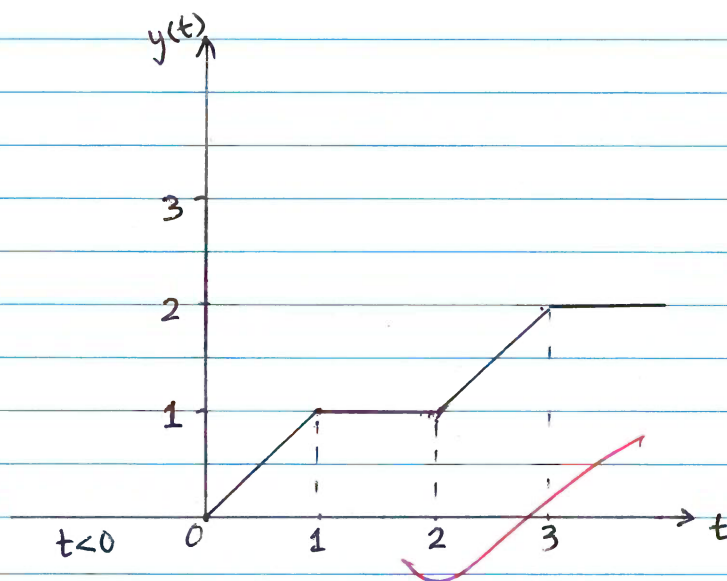
$$y(t) = \int_0^1 [1]_0^1 + \int_1^2 [0] + \int_2^3 [1]_2^3$$

$$y(t) = 1 + 3 - 2 = 2$$

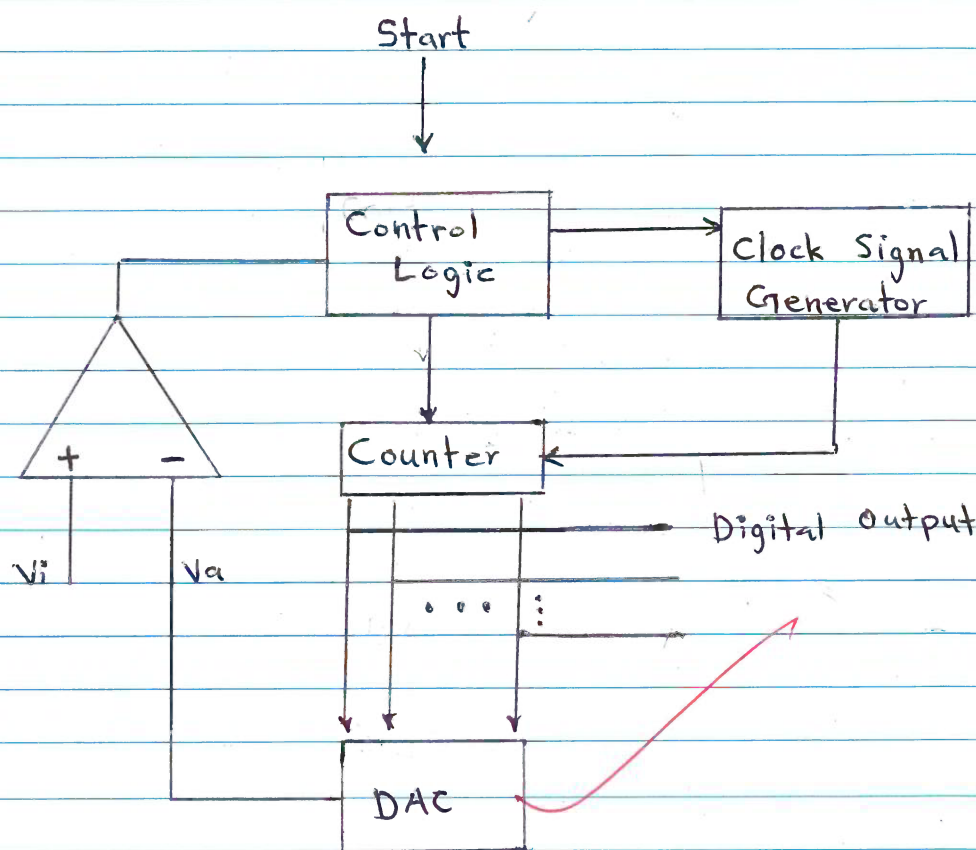
v)

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

vii)



④ a) i)



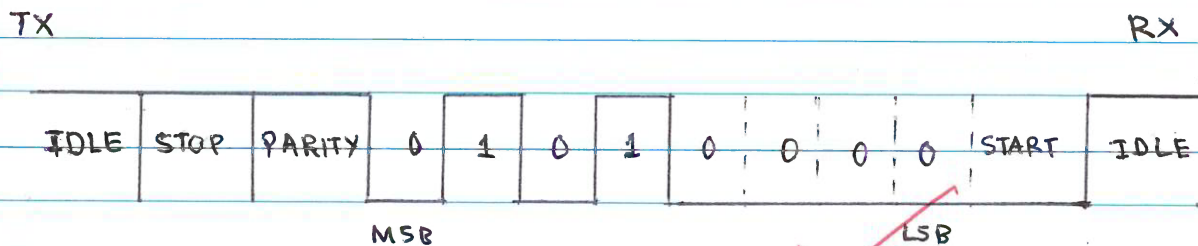
- ii) Control Logic
Clock signal generator
Counter
DAC
Comparator

- iii) The comparator compares the analogue input voltage (V_i) with DAC's output voltage (V_a). If $V_a < V_i$, the comparator outputs 1, which signals the control logic to continue the counting process. If $V_a \geq V_i$, the comparator outputs 0, which signals the control logic to ~~stop~~ disable the ~~control~~ clock signal generator to stop the counting process. At this point, the current value held by the ~~DAC~~ counter is taken as the digital output which is almost equivalent to the analogue input voltage (V_i).

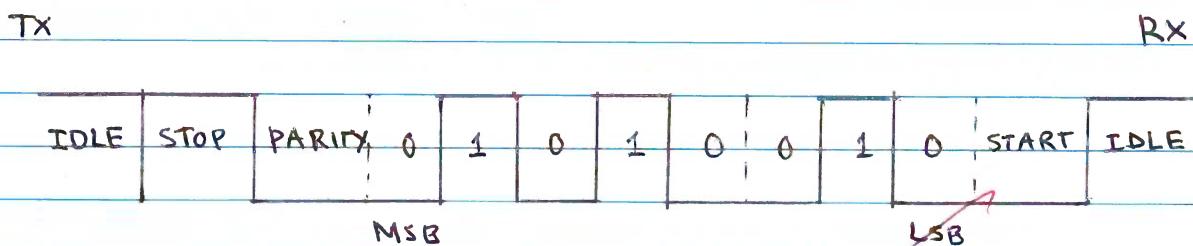
- iv) The DAC converts the received digital input value to an ~~an~~ analogue voltage. This is then needed by the comparator to compare it with the external analogue input voltage.

⑤ a) i) P : $0 \times 50 = 0101\ 0000$
 R : $0 \times 52 = 0101\ 0010$
 I : $0 \times 49 = 0100\ 1001$
 N : $0 \times 4E = 0100\ 1110$
 T : $0 \times 54 = 0101\ 0100$

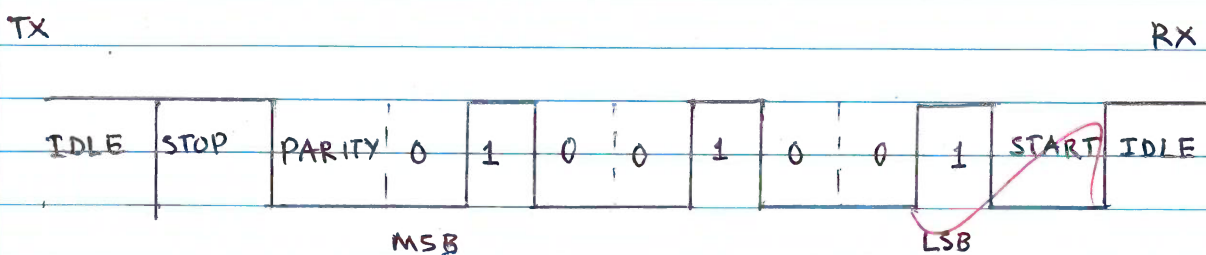
ii) P (odd parity)



R (odd parity)



I (odd parity)



'N' & 'T' missing



Examiner Only

Question No.

