

Even and odd signal :-



Even signal :- (Symmetric signal)

A signal is said to be **SNE** INSTITUTIONS

an even signal if inversion of time axis does not change the amplitude

$$CT: x(t) = x(-t)$$

$$DT: x(n) = x(-n)$$

(eg) cosine wave  $\cos(-\theta) = \cos \theta$

ODD signal :- [Anti symmetric signals]

A signal is said to be an odd signal if inversion of time axis also inverse the amplitude of the signal

$$CT: x(-t) = -x(t)$$

$$DT: x(-n) = -x(n)$$

(eg) sine wave  $\sin(-\theta) = -\sin \theta$

Representation of signals in Even and odd parts :-

$$x(t) = x_e(t) + x_o(t) \rightarrow \textcircled{1}$$

$$x(-t) = x_e(t) - x_o(t) \rightarrow \textcircled{2}$$

Even :  $\textcircled{1} + \textcircled{2}$

$$x(t) + x(-t) = 2x_e(t)$$

$$\therefore x_e(t) = \frac{x(t) + x(-t)}{2}$$

ODD :  $\textcircled{1} - \textcircled{2}$

$$x(t) - x(-t) = 2x_o(t)$$

$$\therefore x_o(t) = \frac{x(t) - x(-t)}{2}$$

Discrete :-



$$x_e(n) = \frac{x(n) + x(-n)}{2}$$

$$x_o(n) = \frac{x(n) - x(-n)}{2}$$



Problems :-

1) find the even and odd components of the signal :-

$$x(t) = \cos t + \sin t$$

$$x_e(t) = \frac{x(t) + x(-t)}{2}$$

$$x(-t) = \cos(-t) + \sin(-t)$$

$$x(-t) = \cos t - \sin t$$

$$x_e(t) = \frac{\cos t + \cancel{\sin t} + \cos t - \cancel{\sin t}}{2}$$

$$x_e(t) = \frac{2 \cos t}{2}$$

$$x_e(t) = \cos t$$

$$x_o(t) = \frac{x(t) - x(-t)}{2}$$

$$= \frac{\cos t + \sin t - (\cos t - \sin t)}{2}$$

$$= \frac{\cos t + \sin t - \cos t + \sin t}{2}$$

$$= \frac{2 \sin t}{2}$$

$$x_o(t) = \sin t$$

2)  $x(t) = \cos t + \sin t + \cos t \cdot \sin t$

$$x_e(t) = \frac{x(t) + x(-t)}{2}$$

$$x(-t) = \cos(-t) + \sin(-t) + \cos(-t) \sin(-t)$$

$$= \cos t - \sin t - \cos t \sin t$$

$$x_e(t) = \frac{\cos t + \cancel{\sin t} + \cos t \cancel{\sin t} + \cos t - \cancel{\sin t} - \cos t \cancel{\sin t}}{2}$$

$$x_e(t) = \frac{2 \cos t}{2}$$

$$x_e(t) = \cos t$$



$$x_o(t) = \frac{x(t) - x(-t)}{2}$$

$$= \frac{\cos t + \sin t + \cos t \sin t - [\cos t - \sin t - \cos t \sin t]}{2}$$

$$= \frac{\cancel{\cos t} + \sin t + \cos t \sin t - \cancel{\cos t} + \sin t + \cos t \sin t}{2}$$

$$= \frac{2[\sin t + \cos t \sin t]}{2} = \sin t [1 + \cos t]$$

③  $x(t) = \sin t + 2\sin t + 2\sin^2 t \cos t$

$x_e(t) = \frac{x(t) + x(-t)}{2}$

$$x(-t) = \sin(-t) + 2\sin(-t) + \cos(-t) - \cos(-t) \cos 2t$$

$$x(-t) = -\cancel{\sin t} - 2\cancel{\sin t} + \cos t - \cos t \cos 2t$$

$$x_e(t) = \frac{2\cos t - 2\cos t \cos 2t}{2} \Rightarrow \frac{2[\cos t - \cos t \cos 2t]}{2}$$

$$x_e(t) = \cos t [1 + \cos 2t]$$

$$x_o(t) = \frac{x(t) - x(-t)}{2}$$

$$x(t) = \sin t + 2\sin t + \cancel{\cos t} - \cancel{\cos t} \cos 2t$$

$$-x(-t) = \sin t + 2\sin t - \cancel{\cos t} + \cancel{\cos t} \cos 2t$$

$$x_o(t) = \frac{2[\sin t + 2\sin t]}{2}$$

$$x_o(t) = 3\sin t$$

④ Find the Even and odd components of the signal :-



$$x(n) = \{ 3, 2, 1, 4, 5 \}$$

$$x(-2) = 3, \quad x(-1) = 2, \quad x(0) = 1, \quad x(1) = 4, \quad x(2) = 5$$

↑  
index value

Even :-

$$x_e(n) = \frac{x(n) + x(-n)}{2}$$

$$n = -2 \quad x_e(-2) = \frac{x(-2) + x(2)}{2} = \frac{3+5}{2} = \frac{8}{2} = 4$$

$$n = -1 \quad x_e(-1) = \frac{x(-1) + x(1)}{2} = \frac{2+4}{2} = 3$$

$$n = 0 \quad x_e(0) = \frac{x(0) + x(0)}{2} = \frac{1+1}{2} = 1$$

$$n = 1 \quad x_e(1) = \frac{x(1) + x(-1)}{2} = \frac{4+2}{2} = 3$$

$$n = 2 \quad x_e(2) = \frac{x(2) + x(-2)}{2} = \frac{5+3}{2} = 4$$

odd :-

$$x_o(n) = \{ 4, 3, 1, 3, 4 \}$$

↑

$$x_o(n) = \frac{x(n) - x(-n)}{2}$$

$$n = -2 \quad x_o(-2) = \frac{x(-2) - x(2)}{2} = \frac{3-5}{2} = \frac{-2}{2} = -1$$

$$n = -1 \quad x_o(-1) = \frac{x(-1) - x(1)}{2} = \frac{2-4}{2} = \frac{-2}{2} = -1$$

$$n = 0 \quad x_o(0) = \frac{x(0) - x(0)}{2} = \frac{1-1}{2} = 0$$

$$n = 1 \quad x_o(1) = \frac{x(1) - x(-1)}{2} = \frac{4-2}{2} = 1$$

$$n = 2 \quad x_o(2) = \frac{x(2) - x(-2)}{2} = \frac{5-3}{2} = 1$$

$$x_o(n) = \{ -1, -1, 0, 1, 1 \}$$

↑

⑤ find the even & odd components of the signal :-



$$x(n) = \{ -2, 1, 2, -1, 3 \}$$

$$x_e(n) = \{ 1/2, 0, 2, 0, 1/2 \}$$

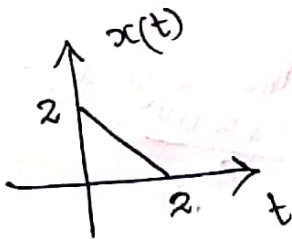
$$x_o(n) = \{ -5/2, 1, 0, -1, 5/2 \}$$

⑥  $x(n) = \{ 1, 0, -1, 2, 3 \}$   
 $x(0) = 1, x(1) = 0, x(2) = -1, x(3) = 2, x(4) = 3$

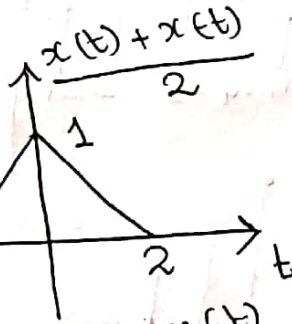
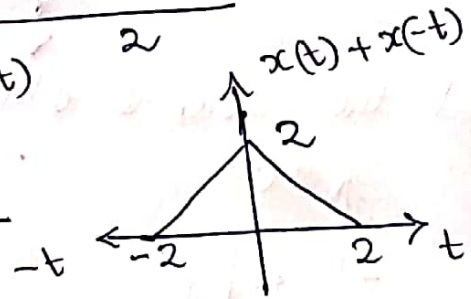
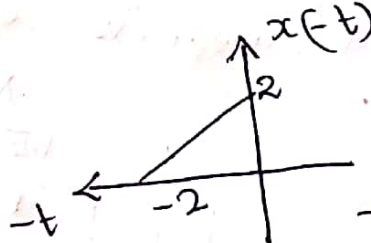
$$x_e(n) = \{ 1, 0, -1/2, 1, 3/2 \}$$

$$x_o(n) = \{ 0, 0, -1/2, 1, 3/2 \}$$

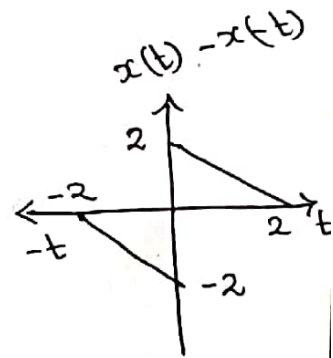
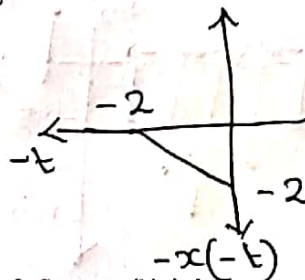
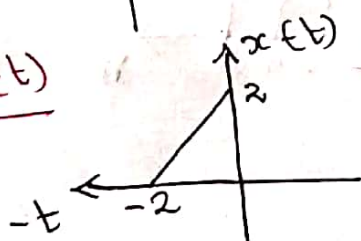
⑦ Find the even & odd components of the signal :-

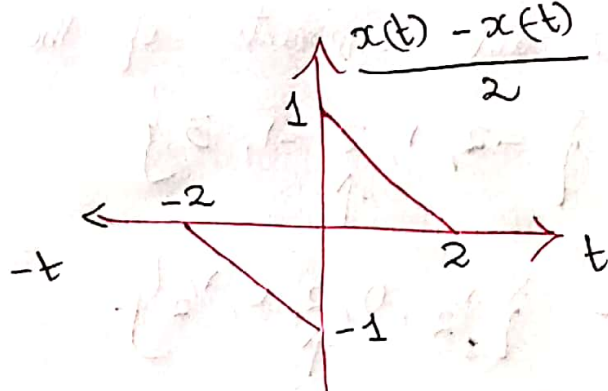


$$x_e(t) = \frac{x(t) + x(-t)}{2}$$

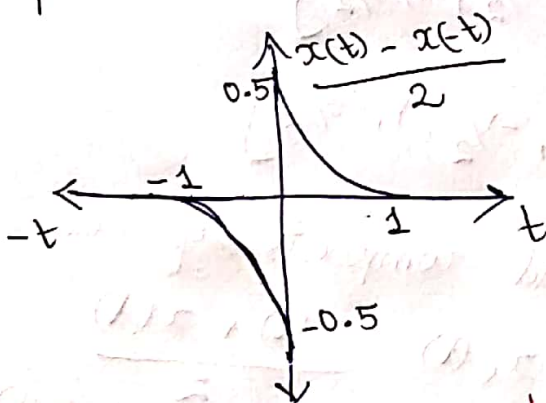
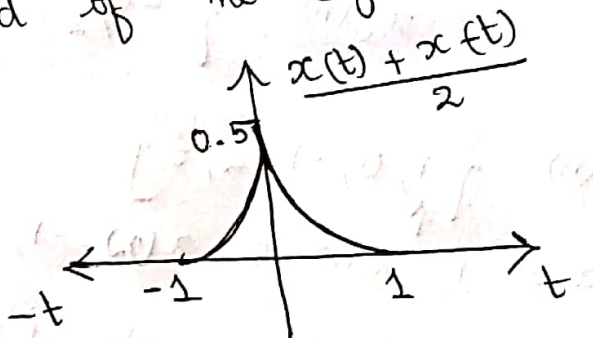
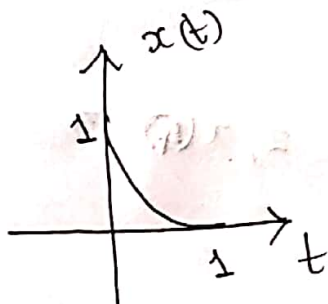


$$x_o(t) = \frac{x(t) - x(-t)}{2}$$





8 Find the even & odd of the signal :-



9 Find the even & odd components of the signal :-

