Gate EE 2023
EE1205 Signals and Systems

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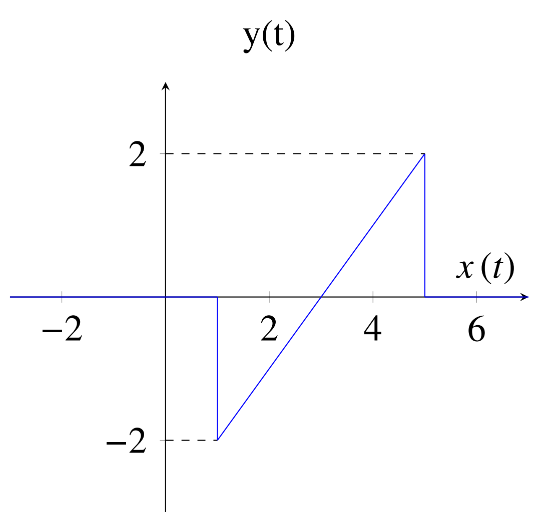
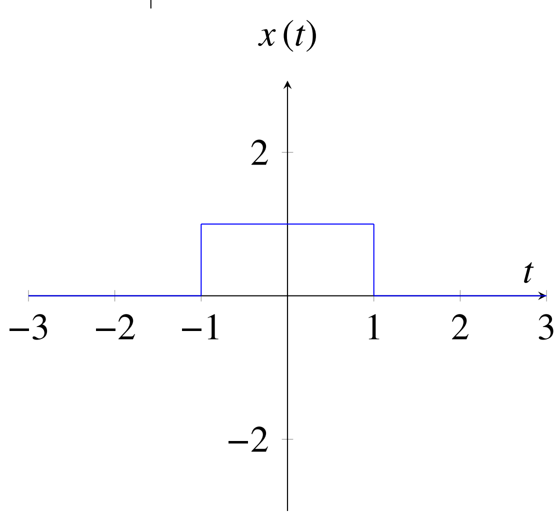
EE23BTECH11044

Question Gate 2023 EE: For the signals x(t) and y(t) shown in the figure, $z(t) = x(t) * y(t)$ is maximum at $t = T_1$. Then T_1 in seconds is .... (Round off to the nearest integer)





Solution:

$$z(t) = x(t) * y(t) = y(t) * x(t) \tag{1}$$

$$z(t) = \int_{-\infty}^{\infty} y(\tau)\, x(t-\tau)\, d\tau \tag{2}$$

$x(\tau)$ is an even signal,

$$x(\tau) = x(-\tau) \tag{3}$$

$$x(-\tau) = \begin{cases} 1 & ; -1 \le -\tau \le 1 \\ 0 & ; \text{otherwise} \end{cases} \tag{4}$$

$$x(-\tau) \xleftrightarrow{\text{Time shifting}} x(t-\tau) \tag{5}$$

$$x(t-\tau) = \begin{cases} 1 & ; t-1 \le t-\tau \le t+1 \\ 0 & ; \text{otherwise} \end{cases} \tag{6}$$

For $z(t)$ to be maximum both $y(\tau)$ and $x(t-\tau)$ must be maximum,

$$\implies t-1 = 3 \quad \text{or} \quad t+1 = 5$$
$$t = T_1 = 4$$