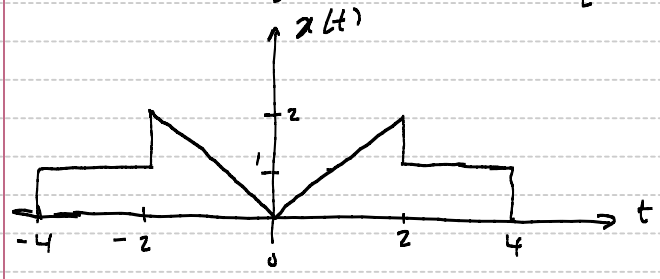
EE 362 Chapter 1: Examples

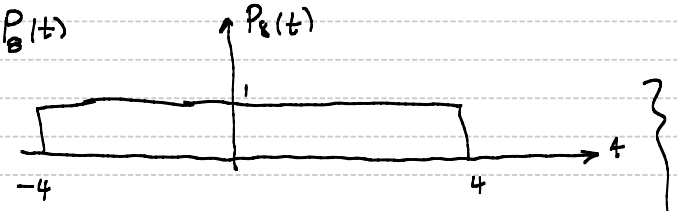
① Shows that the following signal is equal to a sum of rectangular pulses $P_\tau(t)$ and/or triangular pulses $(1-\frac{2|t|}{\tau})P_\tau(t)$.



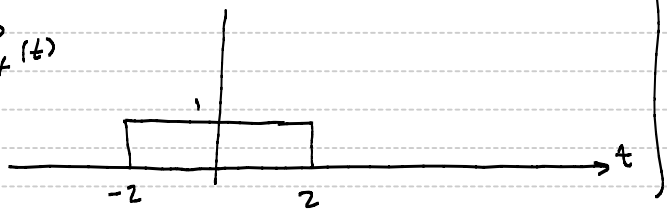
"Solution"

It is clear that this signal is a sum of rectangular and triangular functions

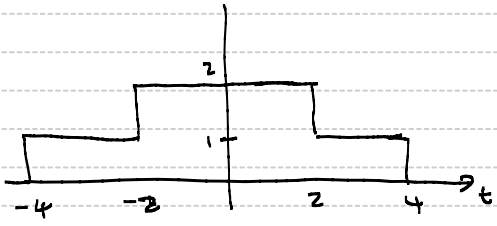
① $P_8(t)$



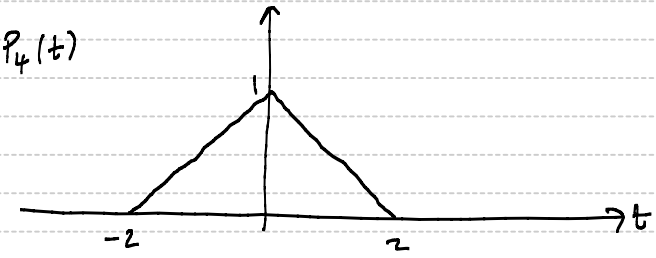
② $P_4(t)$



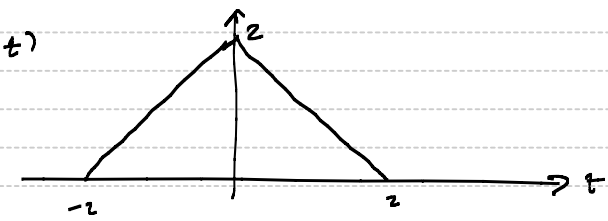
① + ② ⇒



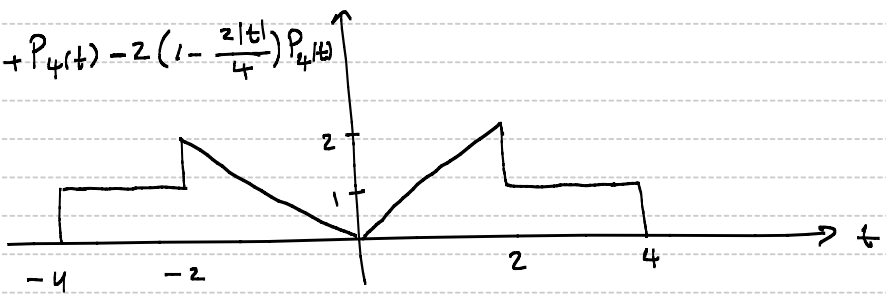
③ $(1-\frac{2|t|}{4})P_4(t)$



④ $2(1-\frac{2|t|}{4})P_4(t)$ $\quad (2-\frac{4|t|}{4})$



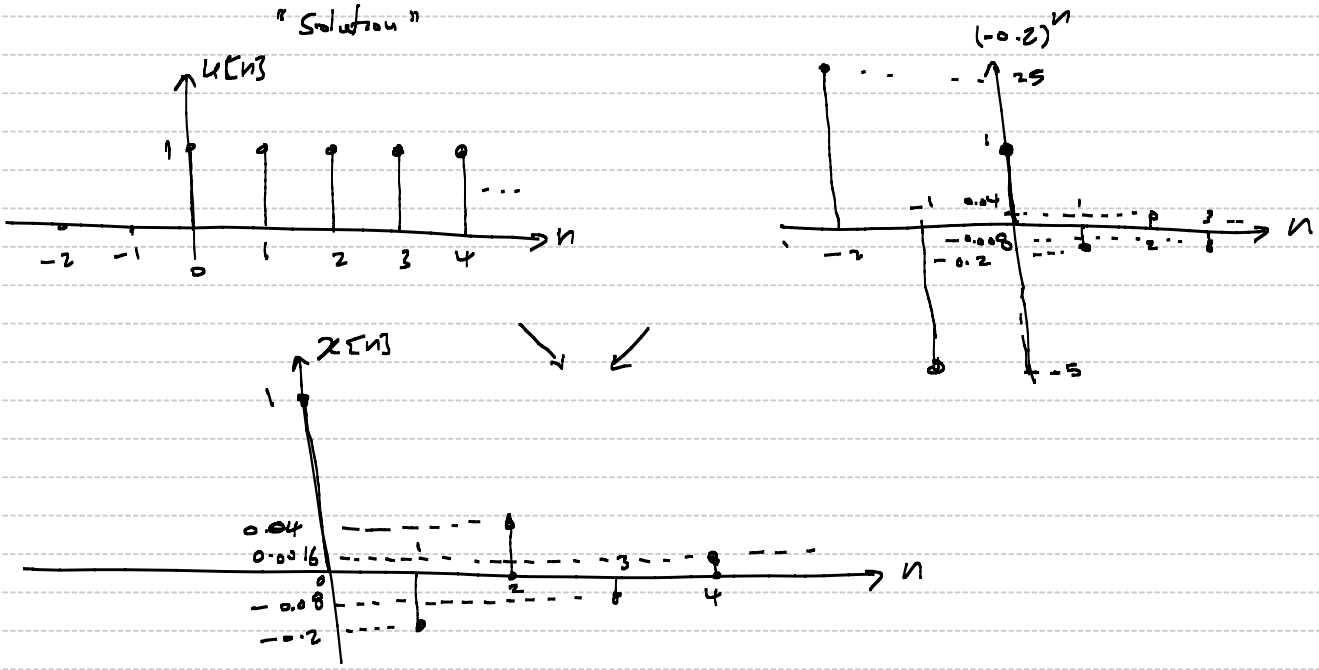
∴ ① + ② − ③ ⇒ $P_8(t)+P_4(t)-2(1-\frac{2|t|}{4})P_4(t)$



② Sketch the following discrete-time signal

$$x[n] = (-0.2)^n u[n]$$

"Solution"



③ Determine system properties: (a) $y(t) = \cos(t)\, x(t)$ (b) $y(t) = x^4(t)$

(a)

① The system is "memoryless"

② Linearity: $x_1(t) \rightarrow y_1(t) = \cos(t)\, x_1(t)$

$x_2(t) \rightarrow y_2(t) = \cos(t)\, x_2(t)$

$a x_1(t) + b x_2(t) \rightarrow a\cos(t) x_1(t) + b\cos(t) x_2(t)$ ⇕ ✓

$a y_1(t) + b y_1(t) \rightarrow a\cos(t) x_1(t) + b\cos(t) x_2(t)$

③ Causality: yes

④ Time-invariance?

$x(t) \rightarrow y(t) = \cos(t)\, x(t)$

$x(t-t_1) \rightarrow y(t) = \cos(t)\, x(t-t_1)$

$y(t-t_1) = \cos(t-t_1)\, x(t-t_1)$

"No"

(b) $y(t) = x^4(t)$

(1) Memoryless: yes

(2) Linear: No

$$x_1(t) \longrightarrow y_1(t) = x_1^4(t)$$

$$x_2(t) \Rightarrow y_2(t) = x_2^4(t)$$

$$a x_1(t) + b x_2(t) \Rightarrow \left(a x_1(t) + b x_2(t)\right)^4$$

But $\quad a y_1(t) + b y_2(t) = a x_1^4(t) + b x_2^4(t)$

(3) Causal: yes

(4) Time-invariant: Yes

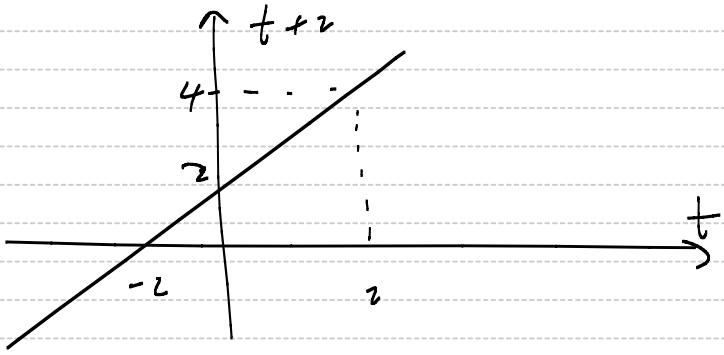
$$x(t) \longrightarrow y(t) = x^4(t)$$

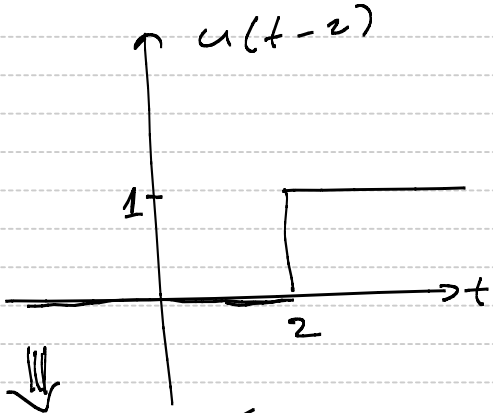
$$x(t-t_1) \Rightarrow y(t) = x^4(t-t_1)$$

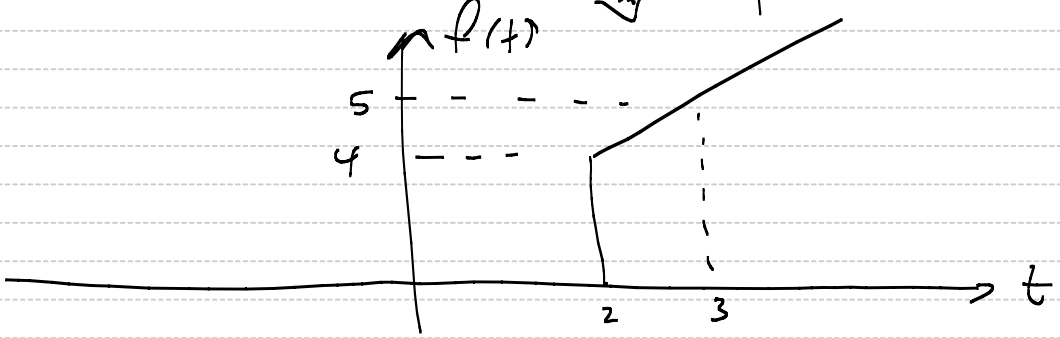
$$y(t-t_1) = x^4(t-t_1)$$

[4] sketch the following function

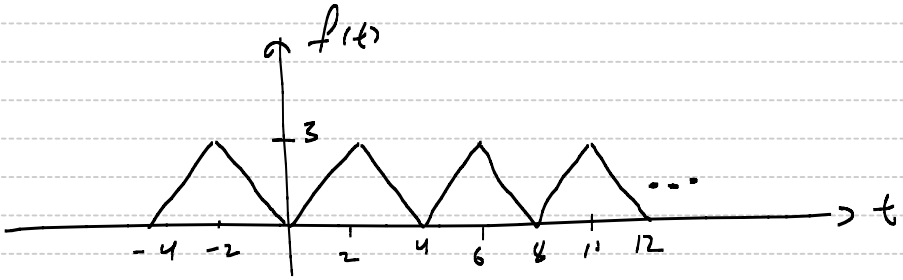
$f(x) = (t+2)\,u(t-2)$







[5]



$$f(t) = 3\left(1 - \frac{2|t+2|}{4}\right) P_4(t+2)$$
$$+3\left(1 - \frac{2|t-2|}{4}\right) P_4(t-2)$$
$$+3\left(1 - \frac{2|t-6|}{4}\right) P_4(t-6)$$
$$+ \cdots$$

$$f(t) = 3\sum_{i=0}^{\infty}\left(1 - \frac{2|t+2-4i|}{4}\right) P_4(t+2-4i)$$