

Solutions Exercises Lecture 1

November 17, 2020

Exercises

Exercise 1.1.

$$\text{sign}(t) = 2u(t) - 1 \quad \frac{d}{dt}\text{sign}(t) = 2\frac{du}{dt} = 2\delta(t)$$

Exercise 1.2.

$$\delta(at + b) = \delta[a(t + b/a)] = \frac{1}{|a|}\delta(t + b/a)$$

Exercise 1.3.

$$f(t) = \int_{\tau=-\infty}^t \delta(\tau) d\tau$$

We observe that

$$f(t) = 0 \quad t < 0 \quad \text{and} \quad f(t) = 1 \quad t > 0$$

Conclusion: $f(t) = u(t)$

Exercise 1.6.

$$f(t)\delta(t) = f(0)\delta(t), \quad t\delta(t) = 0, \quad \int_{t=-\infty}^{\infty} t\delta(t) dt = 0$$

Exercise 1.7. $f(t) = \sin(\pi t)u(t)$ (sketch this signal!)

$$\begin{aligned} \frac{df}{dt} &= \pi \cos(\pi t)u(t) + \sin(\pi t)\frac{du}{dt} \\ &= \pi \cos(\pi t)u(t) + \sin(\pi t)\delta(t) \\ &= \pi \cos(\pi t)u(t) \end{aligned}$$

Exercise 1.8. $g(t) = \cos(\pi t)u(t)$ (sketch this signal!)

$$\frac{dg}{dt} = -\pi \sin(\pi t)u(t) + \delta(t)$$