

Homework 1

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Problem 1 (Zero-crossings for CT signals). Find the points where these signals take on value 0, i.e. when they cross the time axis. Note that for some of them there may be multiple places where they cross the axis.

- (a) $x(t) = 5t - 4$
- (b) $x(t) = 2t^2 - 7t + 6$
- (c) $x(t) = 3 \cos(100\pi t + 50\pi)$
- (d) $x(t) = \frac{t-1}{t+1}$
- (e) $x(t) = \frac{\sin(4\pi t)}{\pi t}$

You can verify your answers using MATLAB.

Problem 2 (Limits for CT signals). Find the limiting values as $t \rightarrow \infty$ of the following signals.

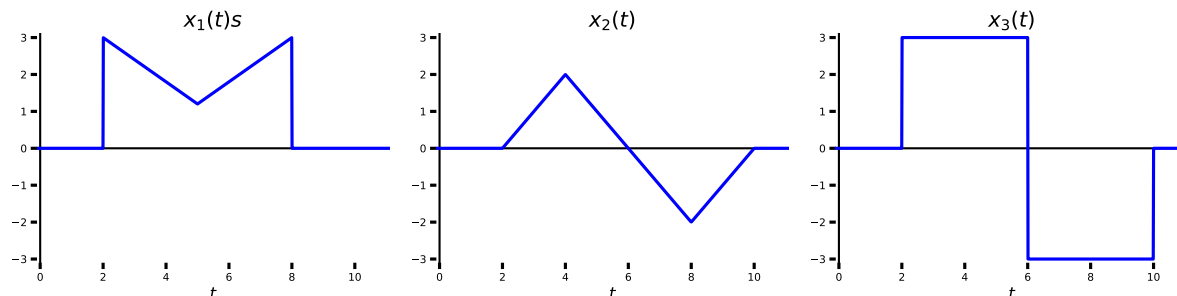
- (a) $x(t) = \frac{1}{t} \log(t)$
- (b) $x(t) = t^2 e^{-t}$
- (c) $x(t) = e^{-2t} \sin(10\pi t)$
- (d) $x(t) = \frac{3t+1}{2t+5}$

You can verify your answers using MATLAB.

Problem 3 (Complex signals). For each of the following complex signals, calculate the magnitude and phase functions analytically.

- (a) $x(t) = e^{-j(t/2+3)}$
- (b) $x(t) = e^{-jt/2} + 2e^{-jt/3}$
- (c) $x[n] = 3e^{j(\pi/6)n}$
- (d) $x[n] = 3e^{j(\pi/6)n} + 2e^{j(\pi/9)n}$

Problem 4 (Steps and ramps, SSTA 1.27). Find formulas for these signals in terms of steps and ramps.



Problem 5 (CT periodic signals, SSTA 1.26). Determine the period of each of the following waveforms. If the signal is not periodic, explain why.

(a) $x(t) = \sin(2t)$

(b) $x(t) = \cos\left(\frac{\pi}{3}t\right)$

(c) $x(t) = \cos^2\left(\frac{\pi}{3}t\right)$

(d) $x(t) = \cos(4\pi t + \pi/3) - \sin(4\pi t + \pi/3)$

(e) $x(t) = \cos\left(\frac{4}{\pi}t + \frac{\pi}{6}\right) - \sin\left(4\pi t + \frac{\pi}{6}\right)$

Problem 6 (DT periodic signals, SSTA 7.3). Compute the fundamental periods and fundamental angular frequencies of the following signals. If the signal is not periodic, explain why.

(a) $7 \cos(0.16\pi n + 2)$

(b) $7 \cos(0.16n + 2)$

(c) $3 \cos(0.16\pi n + 1) + 4 \cos(0.15\pi n + 2)$

Problem 7 (CT power and energy). Determine power and energy for each of the following CT signals to decide if they are energy-type, power-type, or neither.

(a) $x_1(t) = e^{-2t}u(t)$

(b) $x_2(t) = e^{j(2t+\pi/4)}$

(c) $x_3(t) = \cos(t)$

Problem 8 (DT signals). For each of the following DT signals determine (analytically) the power and energy to decide if they are energy-type, power-type, or neither.

(a) $x_1[n] = \left(\frac{1}{2}\right)^n u[n]$

(b) $x_2[n] = e^{j(\pi/2n+\pi/8)}$

(c) $x_3[n] = \cos\left(\frac{\pi}{4}n\right)$