Signals and Systems

Assignment 1

Spring 2021

MohammadKhalaji76@gmail.com - JaliliA370@gmail.com
Telegram Channel: @sig_sys_99

Question 1 (4 pts)

Determine the values of P_∞ and E_∞ for each of the following signals.

(a) $x(t) = \frac{1}{2}^{-3|t|}$

(b) $x[n] = 3^n u[-n]$

(c) $x[n] = e^{\pi jn + \frac{\pi}{4}}$

(d) $x(t) = cos(\omega t)$ (what is the relationship between P_∞ and ω? why?)
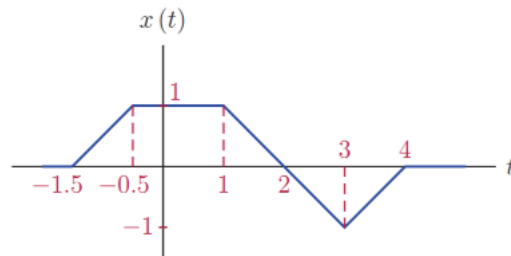
(e) $x(t) = cos(2t) + jcos(t)$

(f) $x[n] = e^{jn + n}$

Question 2 (1 pts)

For signal x(t) shown in the figure, plot the following (step-by-step):
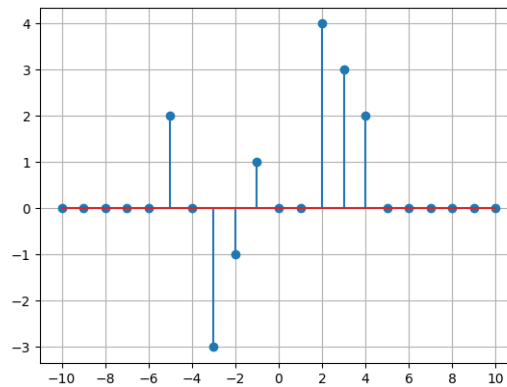
(a) $x_1(t) = x(\frac{t+1}{5})$

(b) $x_2(t) = x(-2t + 1)$

For signal x[n] shown in the figure, plot the following (step-by-step):

(c) $x_3[n] = x[2n + 1]$

(d) $x_4[n] = \begin{cases} x[\frac{n}{2}] & ,n \quad even \\ 0 & ,n \quad odd \end{cases}$

Question 3 (1.5 pts)

For each of the signals listed below, find the even and odd components $Ev\{x(t)\}$ and $Od\{x(t)\}$.

(a) $x(t) = cos(t)u(t)$

(b) $x(t) = e^{-2|t|}sin(t)$

(c) $x(t) = 2\Pi(t + 3.5)$ (solve by sketching)

(d) $x[n] = \delta[n] + u[n]$ (plot the results)

(e) $x[n] = (n + 1)^2$

note: $\Pi(t) = rect(t) = unitpulse = u(t + 0.5) - u(t - 0.5)$

Question 4 (8 pts)

Determine if each signal is periodic. If so, determine the fundamental period and the fundamental frequency.

(a) $x(t) = e^{j\pi t}$

(b) $x(t) = e^{(1+\pi j)t}$

(c) $x(t) = e^{(-2+3j)t} \times e^{(2-2j)t}$

(d) $x[n] = e^{j\frac{\pi}{3}n}$

(e) $x[n] = e^{j4n}$

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

(g) $x(t) = \cos(6\pi t) + \sin(4\pi t)$

(h) $x[n] = \cos(\frac{2\pi}{7}n) + e^{j\frac{5\pi}{3}n}$

(i) $x[n] = \sum_{k=-\infty}^{\infty} \delta[n-5k] + \delta[n-1-5k] + 2\delta[n+2-5k]$

(j) $x[n] = \cos^2(\frac{2\pi}{9}n + \frac{\pi}{6}) + \sin(\frac{5\pi}{3}) + 2\sin(\frac{3\pi}{5}n)$

(k) $x(t) = Od\{\cos(\pi t)u(t)\}$

(l) $x[n] = \cos(\frac{\pi}{8}n^2)$

Question 5 (8 pts)

Determine whether or not the following systems are memoryless, causal, time-invariant, stable and linear:

(a) $y(t) = cos(t)$

(b) $y[n] = x[n-1]$

(c) $y[n] = \sum_{-K}^{+K} x[n-k]$

(d) $y(t) = cos(t)x(t)$

(e) $y(t) = e^{tx(t)}$

(f) $y(t) = \int_{-\infty}^{t+1} x(\tau)d\tau$

(g) $y[n] = x[3n+2]$

(h) $y[n] = sin(x[n])$

(i) $y(t) = x(cos(t) - 1)$

Question 6 (3 pts)

Determine if each of the given systems is invertible. If so, find the invert system.

(a) $y(t) = x(2t)$

(b) $y[n] = x^2[n]$

(c) $y[n] = x[n-1]x[n-3]$

(d) $y(t) = \begin{cases} x(t) & ,t \geq 1 \\ x(t-2) & ,t < 1 \end{cases}$

(e) $y[n] = \begin{cases} x[n] & ,n \geq 0 \\ x[1] & ,-2 \leq n < 0 \\ x[n+2] & ,n < -2 \end{cases}$
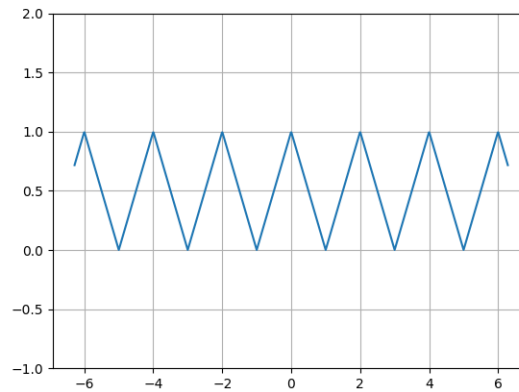
(f) $y(t) = \dfrac{d^2 x(t)}{dt^2}$

Programming Assignment (5 pts)

Plot the following signals within interval $-2\pi \leq t \leq 2\pi$.
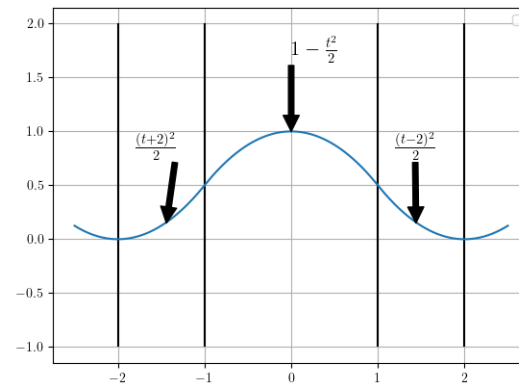
(a) $x(t) = sin(3t)$

(b) $x(t) = sin(\frac{\pi}{2}t)$

(c)

(d)

(e) $x[n] = \displaystyle\sum_{k=-\infty}^{\infty} \delta[n-5k] + \delta[n-1-5k] + 2\delta[n+2-5k]$ (use loops and conditionals)