

## Processamento Digital de Sinais

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### Lista de exercícios 1A – Sinais e sistemas digitais

**P2.1** Generate the following sequences using the basic MATLAB signal functions and the basic MATLAB signal operations discussed in this chapter. Plot signal samples using the **stem** function.

1.  $x_1(n) = 3\delta(n+2) + 2\delta(n) - \delta(n-3) + 5\delta(n-7)$ ,  $-5 \leq n \leq 15$ .
2.  $x_2(n) = \sum_{k=-5}^5 e^{-|k|} \delta(n-2k)$ ,  $-10 \leq n \leq 10$ .
3.  $x_3(n) = 10u(n) - 5u(n-5) - 10u(n-10) + 5u(n-15)$ .
4.  $x_4(n) = e^{0.1n} [u(n+20) - u(n-10)]$ .
5.  $x_5(n) = 5[\cos(0.49\pi n) + \cos(0.51\pi n)]$ ,  $-200 \leq n \leq 200$ . Comment on the waveform shape.
6.  $x_6(n) = 2\sin(0.01\pi n) \cos(0.5\pi n)$ ,  $-200 \leq n \leq 200$ . Comment on the waveform shape.
7.  $x_7(n) = e^{-0.05n} \sin(0.1\pi n + \pi/3)$ ,  $0 \leq n \leq 100$ . Comment on the waveform shape.
8.  $x_8(n) = e^{0.01n} \sin(0.1\pi n)$ ,  $0 \leq n \leq 100$ . Comment on the waveform shape.

**P2.3** Generate the following periodic sequences and plot their samples (using the **stem** function) over the indicated number of periods.

1.  $\tilde{x}_1(n) = \{\dots, -2, -1, 0, 1, 2, \dots\}_{\text{periodic}}$ . Plot 5 periods.
2.  $\tilde{x}_2(n) = e^{0.1n} [u(n) - u(n-20)]_{\text{periodic}}$ . Plot 3 periods.
3.  $\tilde{x}_3(n) = \sin(0.1\pi n) [u(n) - u(n-10)]$ . Plot 4 periods.
4.  $\tilde{x}_4(n) = \{\dots, 1, 2, 3, \dots\}_{\text{periodic}} + \{\dots, 1, 2, 3, 4, \dots\}_{\text{periodic}}$ ,  $0 \leq n \leq 24$ . What is the period of  $\tilde{x}_4(n)$ ?

**P2.4** Let  $x(n) = \{2, 4, -3, 1, -5, 4, 7\}$ . Generate and plot the samples (use the **stem** function) of the following sequences.

1.  $x_1(n) = 2x(n-3) + 3x(n+4) - x(n)$
2.  $x_2(n) = 4x(4+n) + 5x(n+5) + 2x(n)$
3.  $x_3(n) = x(n+3)x(n-2) + x(1-n)x(n+1)$
4.  $x_4(n) = 2e^{0.5n}x(n) + \cos(0.1\pi n)x(n+2)$ ,  $-10 \leq n \leq 10$

**P2.5** The complex exponential sequence  $e^{j\omega_0 n}$  or the sinusoidal sequence  $\cos(\omega_0 n)$  are periodic if the *normalized* frequency  $f_0 \triangleq \frac{\omega_0}{2\pi}$  is a rational number; that is,  $f_0 = \frac{K}{N}$ , where  $K$  and  $N$  are integers.

1. Prove the above result.
2. Generate  $\exp(0.1\pi n)$ ,  $-100 \leq n \leq 100$ . Plot its real and imaginary parts using the **stem** function. Is this sequence periodic? If it is, what is its fundamental period? From the examination of the plot what interpretation can you give to the integers  $K$  and  $N$  above?
3. Generate and plot  $\cos(0.1n)$ ,  $-20 \leq n \leq 20$ . Is this sequence periodic? What do you conclude from the plot? If necessary examine the values of the sequence in MATLAB to arrive at your answer.

Obs: na P2.3 e P2.4, é interessante obter os gráficos dos sinais intermediários.

Fonte: Ingle/Proakis, Digital Signal Processing Using Matlab - 3ª Edição.