

Assignment 1 - EECS 3451 - Fall 2015

Q1.

Use the Jupyter Notebook to sketch each of the following CT signals as a function of the independent variable t over the specified range (**Note: Submit 2, 4, 6 for the Assignment**):

1. $x_1(t) = \cos(3\pi t/4 + \pi/8)$ for $-1 \leq t \leq 2$
2. $x_2(t) = \sin(-3\pi t/8 + \pi/2)$ for $-1 \leq t \leq 2$
3. $x_3(t) = 5t + 3e^{-t}$ for $-2 \leq t \leq 2$
4. $x_4(t) = (\sin(3\pi t/4 + \pi/8))^2$ for $-1 \leq t \leq 2$
5. $x_5(t) = \cos(3\pi t/4 + \sin \pi t/2)$ for $-2 \leq t \leq 3$
6. $x_6(t) = te^{-2t}$ for $-2 \leq t \leq 3$

Q2.

Use the Jupyter Notebook to sketch each of the following DT signals as a function of the independent variable k over the specified range. (**Note: Submit 2, 4, 6 for the Assignment**):

1. $x_1[k] = \cos(3\pi k/4 + \pi/8)$ for $-5 \leq k \leq 5$
2. $x_2[k] = \sin(-3\pi k/8 + \pi/2)$ for $-10 \leq k \leq 10$
3. $x_3[k] = 5k + 3e^{-k}$ for $-5 \leq k \leq 2$
4. $x_4[k] = |\sin(3\pi k/4 + \pi/8)|$ for $-6 \leq k \leq 10$
5. $x_5[k] = \cos 3\pi k/4 + \sin \pi k/2$ for $-10 \leq k \leq 10$
6. $x_6[k] = ke^{-2k}$ for $-10 \leq k \leq 10$

Q3.

Determine if the following CT signals are periodic. If yes, calculate the fundamental period T_0 for the signal (**Note submit 1, 4, 7 for the Assignment**):

1. $x_1(t) = \sin(-5\pi t/8 + \pi/2)$
2. $x_2(t) = |\sin(-5\pi t/8 + \pi/2)|$
3. $x_3(t) = \sin(6\pi t/7) + 2 \cos(3t/5)$
4. $x_4(t) = e^{j(5t+\pi/4)}$
5. $x_5(t) = e^{j3\pi t/8} + e^{\pi t/86}$
6. $x_6(t) = 2 \cos(4\pi t/5) \times \sin^2(16t/3)$
7. $x_7(t) = 1 + \sin 20t + \cos(30t + \pi/3)$

Q4.

Determine if the following DT signals are periodic. If yes, calculate the fundamental period N_0 for the signal (**Note submit A, D, F for the Assignment**):

1. $x_1[k] = -5 \times (-1)^k$
2. $x_2[k] = e^{j(7\pi k/4)} + e^{j(3k/4)}$
3. $x_3[k] = e^{j(7\pi k/4)} + e^{j(3\pi k/4)}$
4. $x_4[k] = \sin(3\pi k/8) + \cos(63\pi k/64)$
5. $x_5[k] = e^{j7\pi k/4} + \cos(4\pi k/7 + \pi)$
6. $x_6[k] = \sin(3\pi k/8) \cos(63\pi k/64)$

Q5.

Show that the average power of the CT periodic signal $x(t) = A \sin(\omega_0 t + \theta)$ with real valued coefficient A is given by $A^2/2$.

Q6.

Write a set of Python functions that compute and plot the following CT signals. In each case, use a sampling interval of 1 ms.

1. $x(t) = e^{-2t} \sin 10\pi t$
2. A periodic signal $x(t)$ with fundamental period $T = 5$. The value over one period is given by:
$$x(t) = 5t \quad 0 \leq t \leq 5$$

Use the `scipy.signal.sawtooth` function to plot 5 periods over the range $-10 \leq t \leq 15$.
3. The unit step function $u(t)$ over the range $-10 \leq t \leq 10$ using the `numpy.sign` function.
4. The rectangular pulse function $rect(t)$:

$$rect\left(\frac{t}{10}\right) = \begin{cases} 1 & -5 \leq t \leq 5 \\ 0 & elsewhere \end{cases}$$

using the function from C.

5. A periodic signal $x(t)$ with fundamental period $T = 6$. The value over one period is given by:

$$x(t) = \begin{cases} 3 & |t| \leq 1 \\ 0 & 1 < |t| \leq 3 \end{cases}$$

Use the `scipy.signal.square` function.