

L.EEC025 - FUNDAMENTALS OF SIGNAL PROCESSING

Academic year 2023-2024, week 4
 TP (Recitation) problems

Topics: sampling and reconstruction of signals

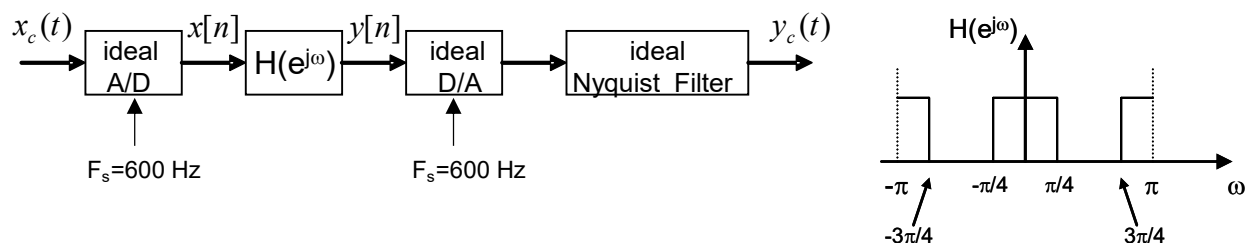
Problem 1

The bandwidth of signals $x_1(t)$ and $x_2(t)$ is limited to Ω_1 and Ω_2 rad/s, respectively. Find the minimum sampling frequency for each one of the following signals:

- a) $x_1(t) + x_2(t)$
- b) $x_1(t) \times x_2(t)$
- c) $x_1(t) * x_2(t)$

Problem 2

The continuous-time signal $x_c(t) = 1 - \sin(200\pi t) + \cos(700\pi t)$ is presented to the input of the following system whose sampling frequency is 600 Hz. Function $H(e^{j\omega})$ represents an ideal stop-pass filter whose stop-band is defined in the range $\pi/4 \leq |\omega| \leq 3\pi/4$. Consider gain 1 in the pass-bands. Notice that an *anti-aliasing* filter does not exist.



- a) If an *anti-aliasing* filter existed at the input of the system, which specifications should it exhibit ?
- b) Find the frequencies (in the range $-\pi \leq \omega < \pi$) that exist in the discrete-time signal $x[n]$.
- c) Considering ideal reconstruction, find an expression for $y_c(t)$.