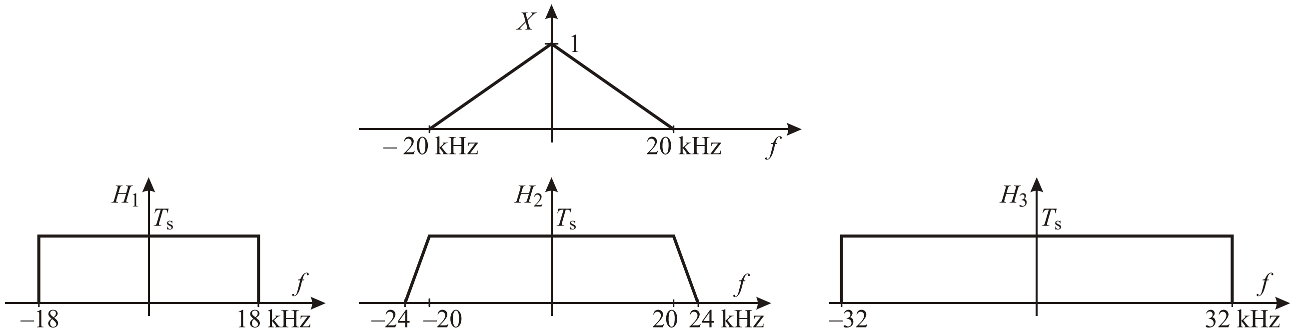
Problem 1 Is ideal impulse train sampling a linear operation? Is it a time-invariant operation?

Problem 2 Determine the sampling period T_s for a successful sampling and reconstruction of the signal

$$x(t) = 1 + \cos(2\text{ Hz} \cdot \pi \cdot t) + 2 \cdot \sin(40\text{ Hz} \cdot \pi \cdot t)$$

Problem 3 A time-continuous signal $x(t)$ shall be sampled with one of the given sampling frequencies: 36 kHz, 44 kHz, 64 kHz. Subsequently the original signal shall be reconstructed with one of the given low-pass filters H_1, H_2, H_3.



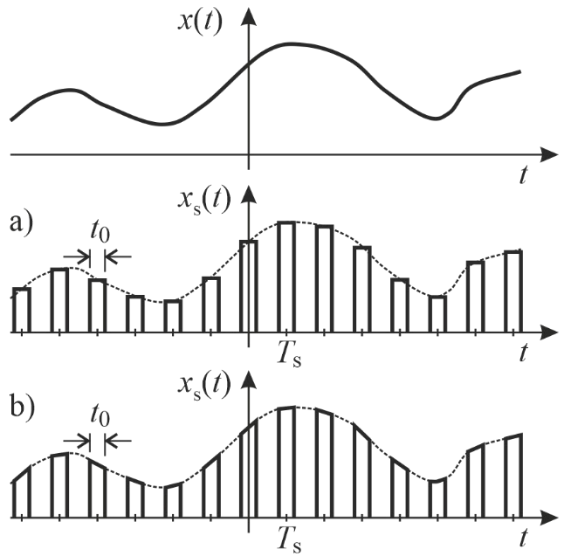
a) Select the minimal sampling frequency for a successful reconstruction.

b) Select one of the given low-pass filters: H_1, H_2, H_3

Problem 4 A real sampling system uses impulses of finite width t_0. Circuit a) is referred as sample-and-hold circuit. Circuit b) is referred as linear-gate circuit.

a) Determine and plot the spectra of the sampled signals $x_s(t)$.

b) Is a perfect reconstruction possible?



Answers

Problem 1 yes, no

Problem 2 < 25 ms

Problem 3 44 kHz; H_2

Problem 4

a) $X_{\mathrm{s}}(f) = \frac{t_0}{T_{\mathrm{s}}} \cdot \mathrm{si}\left(\pi \cdot f \cdot t_0\right) \cdot \sum_{k=-\infty}^{+\infty} X\left(f - k \cdot f_s\right)$

b) $X_{\mathrm{s}}(f) = \frac{t_0}{T_{\mathrm{s}}} \cdot \sum_{k=-\infty}^{+\infty} \mathrm{si}\left(\pi \cdot k \cdot f_{\mathrm{s}} \cdot t_0\right) \cdot X\left(f - k \cdot f_s\right)$