COMMUNICATION THEORY, Homework Exercise 7 Fall 2023

In order to be converted into a digital signal, an analog signal $x(t)$ is first sampled in the time domain by multiplication with a sampling signal $s_p(t) = \sum_{k=-\infty}^{\infty} p(t - kT_s)$ of period $T_s = 1/f_s$. The resulting sampled signal is therefore $x_s(t) = x(t)\, s_p(t)$.

1) Given that $x(t)$ is a baseband signal of bandwidth W = 100 kHz, determine the minimum value of the sampling frequency f_s required to avoid aliasing, according to the Nyquist sampling theorem.

2) Assume any convenient shape of the spectrum of $x(t)$, and draw a sketch of the spectrum of the resulting sampled signal $x_s(t)$, when ideal sampling pulses $p(t) = \delta(t)$ are used, and the sampling frequency is f_s = 300 kHz.

3) Draw a similar sketch to show what happens when the sampling pulses are instead rectangular pulses, $p(t) = B \cdot \prod(Bt)$, with B = 900 kHz.