EE 703: Digital Message Transmission (Autumn 2016)
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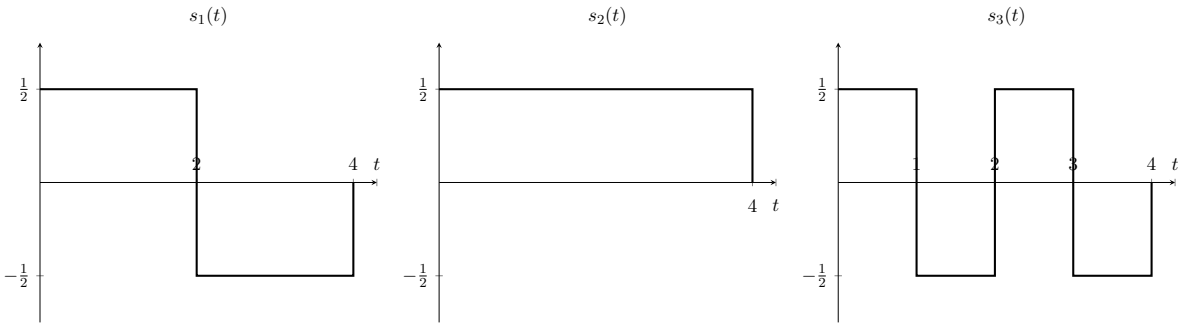
Quiz 1 : 15 points August 29, 2016

1. (5 points) Let $u_p(t)$ and $v_p(t)$ be passband signals centered at the same carrier frequency f_c. Let $u(t) = u_c(t) + ju_s(t)$ and $v(t) = v_c(t) + jv_s(t)$ be the complex baseband representations of $u_p(t)$ and $v_p(t)$ respectively. Prove that

$$\langle u_p, v_p \rangle = \langle u_c, v_c \rangle + \langle u_s, v_s \rangle = \mathrm{Re}\left(\langle u, v \rangle\right).$$

2. (5 points) Consider the three signals given below.



Express the waveform $x(t)$ as a linear combination of $s_i(t), i = 1, 2, 3$, where

$$x(t) = \begin{cases} -1 & 0 \leq t < 1 \\ 1 & 1 \leq t < 3 \\ -1 & 3 \leq t < 4. \end{cases}$$

3. (5 points) Suppose $X(t)$ and $Y(t)$ are independent wide-sense stationary random processes with mean functions equal to μ_X and μ_Y respectively. Let their autocorrelation functions be $R_X(\tau)$ and $R_Y(\tau)$ respectively.
   (a) Show that $Z(t) = X(t) + Y(t)$ is a wide-sense stationary random process.
   (b) Show that $W(t) = X(t)Y(t)$ is a wide-sense stationary random process.