**ECS 332: Principles of Communications** **2015/1**

# HW 9 — Due: Not Due

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**Problem 1.** State the Nyquist's (first) criterion for zero ISI

(a) In the time domain.

(b) In the frequency domain.

**Problem 2.** In each part below, a pulse $P(f)$ is defined in the frequency domain from $f = 0$ to $f = 1$. Outside of $[0, 1]$, your task is to assign value(s) to $P(f)$ so that it becomes a Nyquist pulse. Of course, you will also need to specify the symbol interval $T$ as well.

Hint: To avoid dealing with complex-valued $P(f)$, you may assume that $p(t)$ is real-valued and even; in which case $P(f)$ is also real-valued and even.

(a) Find a Nyquist pulse $P(f)$ whose $P(f) = 0.5$ on $[0, 1]$.

(b) Find a Nyquist pulse $P(f)$ whose $P(f) = 0.25$ on $[0, 1]$.

(c) Find a Nyquist pulse $P(f)$ whose

$$P(f) = \begin{cases} 0.5, & 0 \le f < 0.5 \\ 0.25, & 0.5 \le f \le 1 \end{cases}$$

(d) Find a Nyquist pulse $P(f)$ whose

$$P(f) = \begin{cases} 0.5, & f \in [0, 0.25) \cup [0.5, 0.75) \\ 0.25, & f \in [0.25, 0.5) \cup [0.75, 1] \end{cases}$$

**Problem 3.** Consider a raised cosine pulse $p_{\text{RC}}(t; \alpha)$ and its Fourier transform $P_{\text{RC}}(f; \alpha)$. Assume the rolloff factor $\alpha = 0.3$ and the symbol "duration" $T = 1$.

(a) Carefully sketch $P_{\text{RC}}(f; \alpha)$.

(b) Find $p_{\text{RC}}(2; \alpha)$.

(c) Find $P_{\text{RC}}(0.5; \alpha)$.

(d) Find $P_{\text{RC}}(0.3; \alpha)$.

(e) *Find $P_{\mathrm{RC}}(0.4;\alpha)$.

Remark: You should be able to solve this problem without referring to the "ugly" expression(s).

**Problem 4.** Consider a raised cosine pulse $p(t)$ with rolloff factor $\alpha$ and symbol "duration" $T$.

(a) Find $p(T/2)$ as a function of $\alpha$.

(b) Use `MATLAB` to plot $p(T/2)$ as a function of $\alpha$.