ECS 332: Principles of Communications **2012/1**

HW 5 — Due: Sep 26

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Instructions

(a) ONE part of a question will be graded (5 pt). Of course, you do not know which part will be selected; so you should work on all of them.

(b) It is important that you try to solve all problems. (5 pt)

(c) Late submission will be heavily penalized.

(d) Write down all the steps that you have done to obtain your answers. You may not get full credit even when your answer is correct without showing how you get your answer.

Problem 1. Consider a signal $g(t) = \operatorname{sinc}(3(t-5))$.

(a) Is $g(t)$ time-limited?

(b) Is $g(t)$ band-limited?

(c) Carefully sketch $g(t)$

(d) Carefully sketch the magnitude $|G(f)|$ of the Fourier transform $G(f)$.

Problem 2. State the reconstruction formula.
Hint: You should be able to do this by recalling the reconstruction process.

Problem 3. State the Nyquist's (first) criterion for zero ISI

(a) In the time domain.

(b) In the frequency domain.

Problem 4. 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 5. Consider a raised cosine pulse $p(t)$ and its Fourier transform $P(f)$. Assume the rolloff factor $\alpha = 0.3$ and the symbol "duration" $T = 1$.

(a) Carefully sketch $P(f)$.

(b) Find $p(2)$.

(c) Find $P(0.5)$.

(d) Find $P(0.3)$.

(e) *Find $P(0.4)$.

Remark: You should be able to solve this problem without referring to the "ugly" formula.

Problem 6. Consider a raised cosine pulse $p(t)$ with rolloff factor α and symbol "duration" T.

(a) Find $p(T/2)$ as a function of α.

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