Name ________________________ ID3 _ _ _

ECS 332: Principles of Communications **2017/1**

HW 1 — Due: Sep 1, 4 PM

Lecturer: Prapun Suksompong, Ph.D.

Instructions

(a) This assignment has 5 pages.

(b) (1 pt) Work and write your answers **directly on these provided sheets** (not on other blank sheet(s) of paper). Hard-copies are distributed in class.

(c) (1 pt) Write your first name and the last three digits of your student ID on the upper-right corner of this page.

(d) (8 pt) Try to solve all problems.

(e) Late submission will be heavily penalized.

Problem 1. In class, we have seen how to use the Euler's formula to show that

$$\cos^2 x = \frac{1}{2}\left(\cos\left(2x\right) + 1\right).$$

For this question, ***apply similar technique*** to show that

$$\cos A \cos B = \frac{1}{2}\left(\cos\left(A + B\right) + \cos\left(A - B\right)\right).$$

Problem 2. Plot (by hand) the Fourier transforms of the following signals

(a) $\cos(20\pi t)$

(b) $\cos(20\pi t) + \cos(40\pi t)$

(c) $(\cos(20\pi t))^2$

(d) $\cos(20\pi t) \times \cos(40\pi t)$

(e) $(\cos(20\pi t))^2 \times \cos(40\pi t)$

Problem 3. Evaluate the following integrals:

(a)

(i) $\int\limits_{-\infty}^{\infty} 2\delta(t)\, dt$

(ii) $\int\limits_{-3}^{2} 4\delta(t-1)\, dt$

(iii) $\int\limits_{-3}^{2} 4\delta(t-3)\, dt$

(b) $\int\limits_{-\infty}^{\infty} \delta(t)\, e^{-j2\pi ft} dt$

(c)

(i) $\int\limits_{-\infty}^{\infty} \delta(t-2)\sin(\pi t) dt$

(ii) $\int\limits_{-\infty}^{\infty} \delta(t+3)\, e^{-t} dt$

(iii) $\int\limits_{-\infty}^{\infty} e^{(x-1)} \cos\left(\frac{\pi}{2}(x-5)\right) \delta(x-3) dx$

(d)

(i) $\int\limits_{-\infty}^{\infty} (t^3+4)\, \delta(1-t) dt$

(ii) $\int\limits_{-\infty}^{\infty} g(2-t)\, \delta(3-t) dt$

(e) $\int\limits_{-2}^{2} \delta(2t)\, dt$

Problem 4. Consider the signal $g(t)$ shown in Figure 1.1.

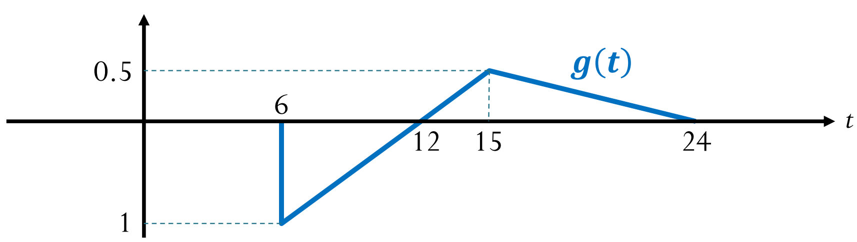

Figure 1.1: Problem 4

(a) Carefully sketch the following signals:

(i) $y_1(t) = g(-t)$

(ii) $y_2(t) = g(t+6)$

(iii) $y_3(t) = g(3t)$

(iv) $y_4(t) = g(6-t)$.

(b) Find the "net" area under the graph for each of the signals in the previous part. (Mathematically, this is equivalent to integrating each signal from $-\infty$ to $+\infty$. However, directly calculating and combining positive and negative areas from the plots should be easier.)