Name ________________________ ID3 _ _ _

**ECS 332: Principles of Communications** **2019/1**

# HW 2 — Due: August 30, 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) $\int\limits_{-\infty}^{\infty} \delta(t)\, e^{-j2\pi f t} dt$

(c)

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

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

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

(d)

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

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

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

**Problem 4.** Consider the signal $g(t)$ shown in Figure 2.1.

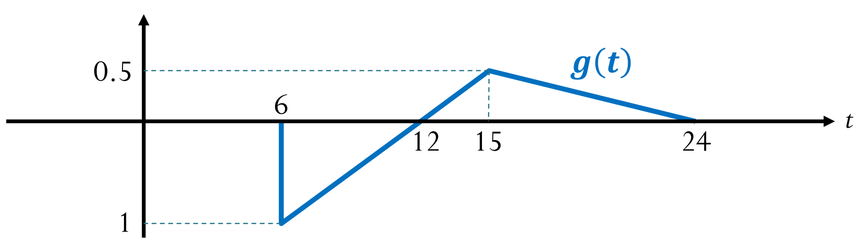


Figure 2.1: Problem 4

(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.)