ECS 332: Principles of Communications **2016/1**

HW 1 — Due: September 2, 5PM

Lecturer: Prapun Suksompong, Ph.D.

Instructions

(a) (1 pt) This assignment has 5 pages. Do not staple or use paper clip. Also, use/print single-sided page. Your submitted work will be scanned using automatic document feeder.

(b) (2 pt) Write your first name and the last three digit of your student ID on the upper-right corner of ***every*** submitted page.

(c) (7 pt) It is important that you try to solve all problems. For each part, write your explanation/derivation and answer in the space provided.

(d) 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.

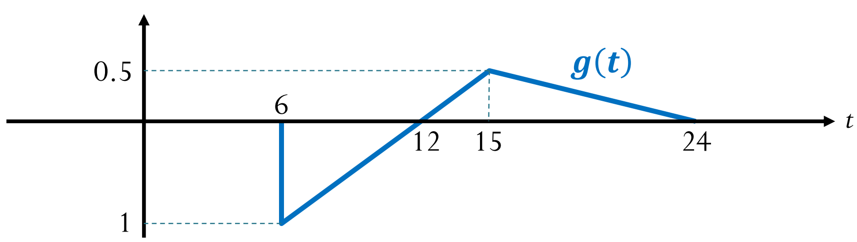

Figure 1.1: Problem 4

(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 area under the curve (integrate from $-\infty$ to $+\infty$) for each of the signals in the previous part.