

ECS 332: Principles of Communications**2018/1**

HW 1 — Due: August 29, 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

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

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

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

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) $\int_{-\infty}^{\infty} 2\delta(t) dt$

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

(iii) $\int_{-3}^2 4\delta(t-3) dt$

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

(c)

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

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

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

(d)

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

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

$$(e) \int_{-2}^2 \delta(2t) dt$$

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

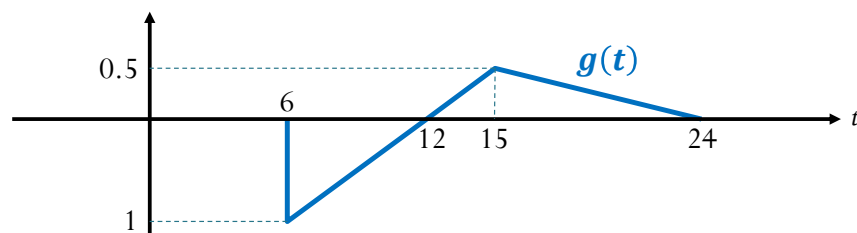


Figure 1.1: Problem 4

(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.)