Name _____ ID3 _ _ _

EES 351: Principles of Communications **2020/1**

HW 2 — Due: September 2, 11:59 PM

Lecturer: Prapun Suksompong, Ph.D.

Instructions

(a) This assignment has 5 pages.

(b) (1 pt) Two choices for submission:

(i) Online submission via Google Classroom

- PDF only. Paper size should be the same as the posted file.
- Only for those who can directly work on the posted PDF file using devices with pen input.
- No scanned work, photos, or screen capture.
- Your file name should start with your 10-digit student ID: "5565242231 315 HW1.pdf"

(ii) Hardcopy submission: Work and write your answers **directly on a hardcopy of the posted file** (not on another blank sheet of paper).

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

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

(e) [ENRpr] = Explanation is not required for this problem.

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

(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 2.1.

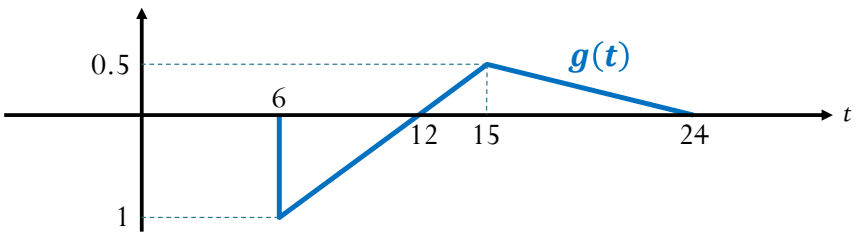

Figure 2.1: Problem 4

(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.)