ECS 332: Principles of Communications **2015/1**

HW 1 — Due: August 27, 12:59 PM (in class)

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Instructions

(a) ONE part of a question will be graded (5 pt). Of course, you do not know which part will be selected; so you should work on all of them.

(b) You must try to solve all problems. (5 pt)

(c) Late submission will be heavily penalized.

(d) Write down all the steps that you have done to obtain your answers. You may not get full credit even when your answer is correct without showing how you get your answer.

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) $\left(\cos(20\pi t)\right)^2$

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

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

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.

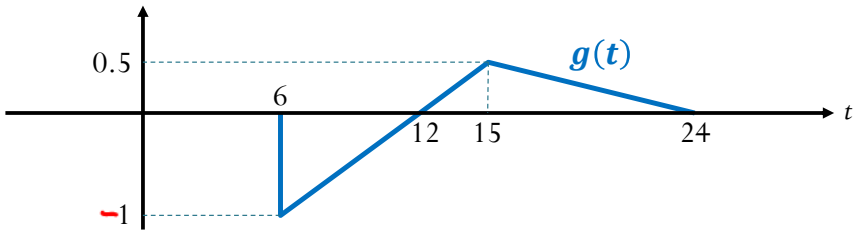

Figure 1.1: Problem 4

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