Name ________________________ ID3 _ _ _

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

HW 3 — Due: September 11, 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 351 HW3.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) Late submission will be heavily penalized.

Problem 1.

(a) Plot (by hand) the *amplitude spectrum* of the signal $x(t) = \begin{cases} 1, & -4 < t < 4, \\ 0, & \text{otherwise.} \end{cases}$

(b) Plot (by hand) the *amplitude spectrum* of the signal $x(t) = \begin{cases} 2, & -2 < t < 2, \\ 0, & \text{otherwise.} \end{cases}$

(c) Plot (by hand) the *amplitude spectrum* of the signal $x(t) = \begin{cases} 2, & -3 < t < 1, \\ 0, & \text{otherwise.} \end{cases}$

Problem 2.

(a) Suppose the Fourier transform of a signal $x(t)$ is given by

$$X(f) = \operatorname{sinc}(5\pi f) = \frac{\sin(5\pi f)}{(5\pi f)}.$$

(i) Plot (by hand) $x(t)$.

(ii) Find $\int_{-\infty}^{\infty} X(f) df$. (Hint: This integration is exactly the inverse Fourier transform formula with $t = 0$.)

(b) Suppose the Fourier transform of a signal $y(t)$ is given by

$$Y(f) = \mathrm{sinc}^2(5\pi f) = \left(\frac{\sin(5\pi f)}{(5\pi f)}\right)^2.$$

(i) Plot (by hand) $y(t)$.

(ii) Find $\int_{-\infty}^{\infty} Y(f)df$.

Problem 3. The Fourier transform of the triangular pulse $g(t)$ in Figure 3.1a is given as

$$G(f) = \frac{1}{(2\pi f)^2}\left(e^{j2\pi f} - j2\pi f e^{j2\pi f} - 1\right)$$

Using this information, and the time-shifting and time-scaling properties, find the Fourier transforms of the signals shown in Figure 3.1b, c, d, e, and f.

Remark: Don't forget to simplify your answers. For example, the answer in part (d) should be of the form $\mathrm{sinc}^2(\cdot)$ and the answer in part (e) should be of the form $\mathrm{sinc}(\cdot)$

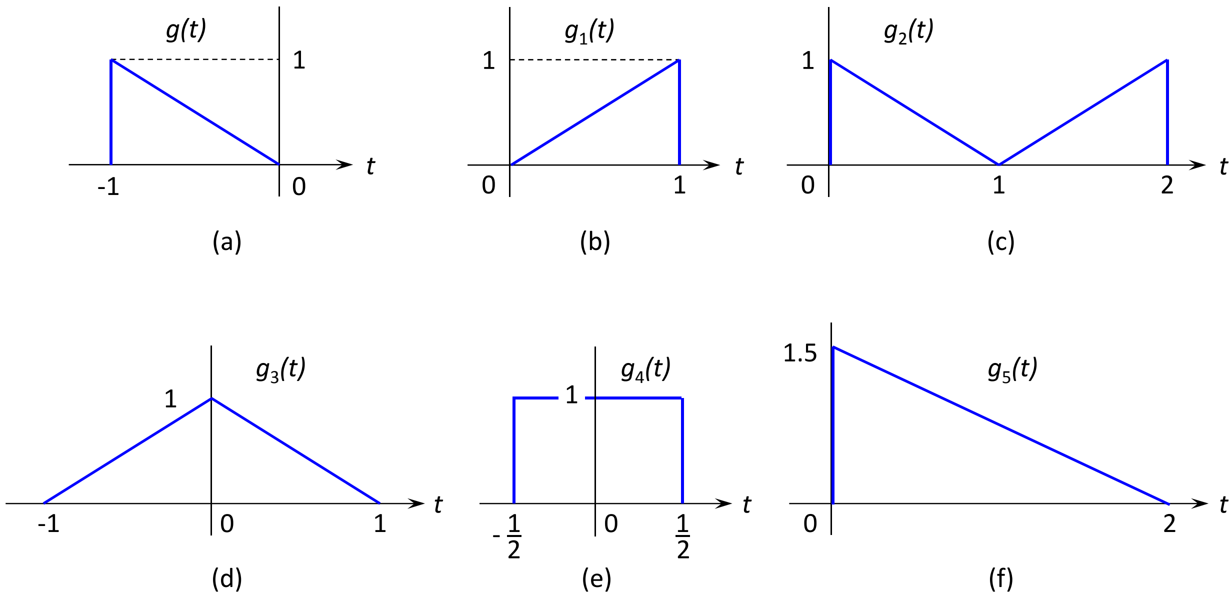

Figure 3.1: Problem 3