Homework Assignment 1

Due: 16:00pm Tuesday, Feb. 7, 2023

Problem 1. Find the inverse Fourier transforms of $G(f)$ for the spectra in Figure 1 (a) and (b).

Note: $G(f) = |G(f)|e^{j\angle G(f)}$.

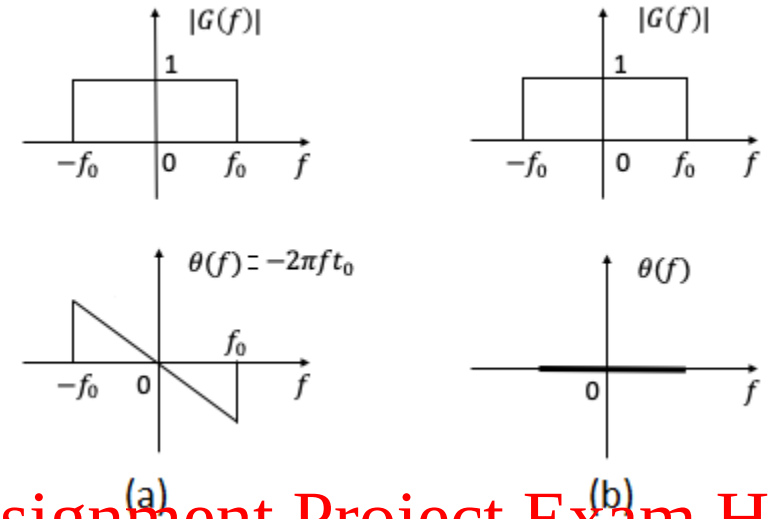

Figure 1: Signals for Problem 1.

Problem 2. Find the Fourier transforms of the signals $g_1(t)$ and $g_2(t)$ in Figure 2 using either the definition of Fourier Transform or the properties of Fourier Transform together with the table of Fourier transform pairs posted on the course website.

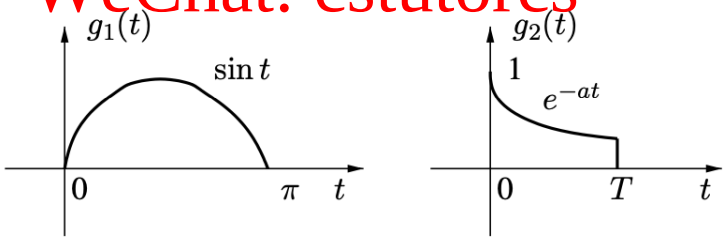

Figure 2: Signals for Problem 2.

Problem 3. a) Prove the following result via properties of Fourier transform: For any signal $g(t)$ with Fourier transform $G(f)$, we have

$$g(t)\sin(2\pi f_c t) \rightleftharpoons \frac{1}{2j}[G(f-f_c) - G(f+f_c)].$$

b) Using the result in (a), please find the Fourier transform of the time-domain signal

$$s(t) = [2 + \cos(2\pi f_0 t)]\sin(200\pi t),$$

where $f_0 > 0$. Draw the spectra.

Note: Consider different ranges of f_0.

Problem 4. (Haykin & Moher Problem 2.20 with revision) Any function $g(t)$ can be split unambiguously into an *even part*, $g_e(t)$, and an *odd part*, $g_o(t)$, as shown by

$$g(t) = g_e(t) + g_o(t),$$

where

$$g_e(t) = \frac{1}{2}\left[g(t) + g(-t)\right], \quad g_o(t) = \frac{1}{2}\left[g(t) - g(-t)\right].$$

a) Evaluate the even and odd parts of $u(t)$.

b) What are the Fourier transforms of these two parts and the Fourier transform of $u(t)$?