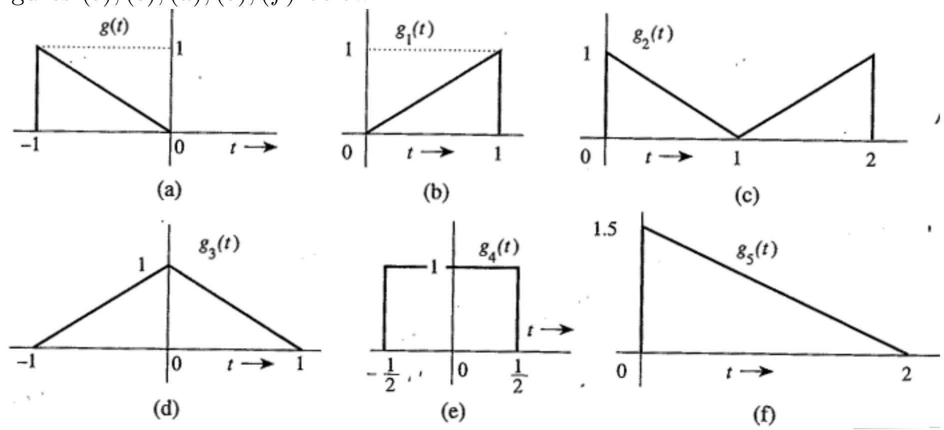
University of Illinois **Fall 2018**

ECE210 / ECE211 - Homework 9

Due : Wednesday, October 31 at 6:00 p.m.

1. Determine the Fourier transform of the following signals, as well as their energy content.
   (a) $x(t) = rect(t-3) + rect(t+3)$.
   (b) $x(t) = 4rect(\frac{t}{4})\cos(2\pi f_c t)$.
   (c) $x(t) = \frac{1}{1+t^2}$.
   (d) $x(t) = t\cos(2\pi f_c t)$.
   (e) $x(t) = (3 + 4\cos(2t))\, e^{5t} u(-t)$.

2. The triangular pulse $g(t)$ in figure (a) below has Fourier transform $G(f) = \frac{1}{(2\pi f)^2}\left(e^{j2\pi f} - j2\pi f e^{j2\pi f} - 1\right)$. Use this information, and properties of the Fourier transform to find the Fourier transforms of the signals shown in figures $(b), (c), (d), (e), (f)$ below.



3. Let $f(t) = \frac{1}{2\pi}\text{sinc}\left(-\frac{t}{6}\right)\left[1 - 2\cos\left(-\frac{t}{6}\right)\right]$, with Fourier transform $F(\omega) = 6\text{rect}(6\omega) - 6\text{rect}(6\omega+1) - 6\text{rect}(6\omega-1)$. Let $G(\omega) = \frac{1}{2\pi}\text{sinc}\left(\frac{\omega}{6}\right)\left[1 - 2\cos\left(\frac{\omega}{6}\right)\right]$.
   (a) Obtain the inverse Fourier transform of $G(\omega)$, that is, obtain $g(t)$.
   (b) Plot $F(\omega)$ and $g(t)$.

4. Determine the 3-dB bandwidth and the 95%-bandwidth of signals $f(t)$ and $g(t)$ with the following energy spectra: