MAE 143 A: Signals and Systems.
Homework #8

Assigned May 26. Due Jun 2

1. Look at the graphs of the signals in Figure 1. Can you say whether or not they are low-pass, high-pass or band-pass signals? Reason your answer.

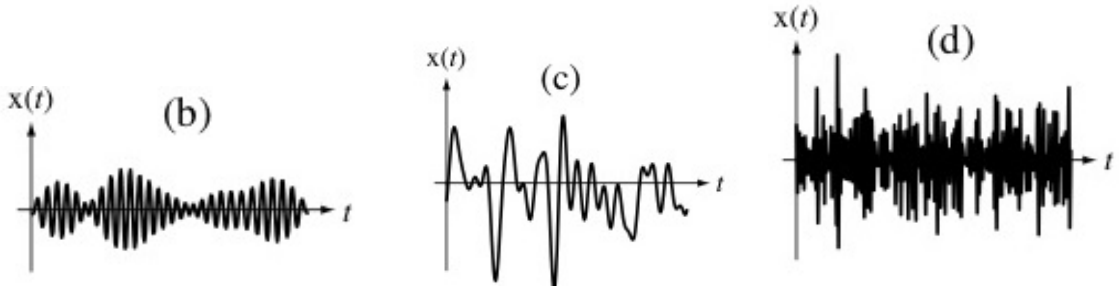

Figure 1: Signals corresponding to Problem 1

2. Find the Fourier transform of the following signals, using the tables and FT properties:
   (a) For $x(t) = \left[2\mathrm{e}^{(-1+j2\pi)t} + 2\mathrm{e}^{(-1-j2\pi)t}\right] u(t)$, find $X(\omega)$.
   (b) For $x(t) = 1.6\mathrm{sinc}^2(-t)\sin(4\pi t)$, find $X(f)$
   (c) For $x(t) = \mathrm{e}^{-t/4}u(t) * \sin(2\pi t)$, find $X(f)$
   (d) For $x(t) = \frac{d}{dt}(\mathrm{sinc}(t))$, find $X(\omega)$
   (e) For $x(t) = \int_{-\infty}^{t} \mathrm{rect}(\lambda)d\lambda$, find $X(\omega)$.
3. Plot the magnitude and phase spectrum of the following signals (you have to use FT tables and the FT properties in order to compute $X(\omega)$):
   (a) $x(t) = \mathrm{sgn}(t) - \mathrm{sgn}(-t)$
   (b) $x(t) = \int_{-\infty}^{t} \sin(2\pi\lambda)d\lambda$. *Hint:* Recall that $\delta(s)$ is a real signal that is zero for $s \neq 0$.
4. Compute the Impulse Response of each of the systems with the Frequency Response given next. Classify each Impulse Response as a low-pass, high-pass or band-pass signal.
   (a) $H(\omega) = 10\left[\delta(\omega - \frac{1}{2}) + \delta(\omega + \frac{1}{2})\right]$
   (b) $H(\omega) = -2\pi\delta(\omega) * j\pi\left(\delta(\omega - 300) - \delta(\omega + 300)\right)$
   (c) $H(\omega) = 3\mathrm{sinc}(f)\mathrm{e}^{-j2\pi f}$
5. Suppose a system Impulse Response is given by $h(t) = 7(u(t) - u(t-20))$. What is the FT of the system response to the signal $x(t) = \mathrm{e}^{-20t}u(t)$?