EE341, Winter 2001
Problem Set #6

Due: 23 February '01

Problem 1 and the first two extra problems are from the Parr and Phillips text.

1. 12.6 b,d

2. Consider the signal $x_c(t) = 10\text{sinc}^2(2\pi f_B t)$ where $f_B = 5kHz$.

   (a) Find the minimum sampling frequency (in Hertz) that can be used with this signal, assuming that you can recover it with an ideal LPF.

   (b) Assuming that you sampled the signal with $f_s = 30kHz$ and then converted it to the discrete-time signal $x_d[n]$, sketch $X_d(\Omega)$ where Ω is in radians. Also sketch $X_d(f)$ where f is in terms of normalized frequence $f = \Omega/2\pi$.

3. For each of the functions below, determine whether it is a valid discrete-time Fourier Transform. For each valid case where the time signal is real, find the inverse Fourier transform. (You may use Table 12.1.)

   (a) $X_1(\Omega) = \frac{e^{j2\Omega}}{1+0.9e^{-j\Omega}}$

   (b) $X_2(\Omega) = \frac{e^{-j\Omega/5}}{1+0.9e^{-j\Omega}}$

   (c) $X_3(\Omega) = 1 + \cos(\frac{3\Omega}{2})$

   (d) $X_4(\Omega) = 5\cos(2\Omega - 0.1\pi)$

   (e) $X_5(\Omega) = 1 + \cos(\Omega - \pi)$

Answers to extra problems:
(for your own use, not to turn in)

- 12.1 (c) $\omega_s > 400$ rad/s; (d) $\omega_s > 200\pi$ rad/s
- 12.6 (c) $V(\Omega) = 2e^{-j2\Omega}(1 + 2\cos(\Omega) + 2\cos(2\Omega))$
- $\mathcal{F}^{-1}\{2\cos(\Omega)\} = \delta[n+1] + \delta[n-1]$
- $X(\Omega) = e^{j\pi\Omega}$ is not a valid Fourier transform
- $\mathcal{F}^{-1}\{e^{-j\Omega}\frac{\sin(7\Omega/2)}{\sin(\Omega/2)}\} = \sum_{k=-2}^{4}\delta[n-k]$