EE321 Sixth Homework Assignment

@ Kefu Xue, Ph.D., Sep. 2001 to Aug. 2007

1 Fourier Transforms

1. Find Fourier transforms of the following functions

   (a) $f_1(t) = 3e^{-3t}u(t-2)$

   (b) $f_2(t) = e^{-2t}[u(t) - u(t-2)]$

   (c) $f_3(t) = 2rect(\frac{t-5}{2})$

   (d) $f_4(t) = rect(\frac{t+1}{2}) + rect(\frac{t-1}{2})$

   (e) $f_5(t) = f_4(2t)$

   (f) $f_6(t) = 2\sin c(4\pi t)$

   (g) $f_7(t) = f_2(t-2)$

   (h) Given Fourier transforms of $\delta(t)$ is 1, use Fourier transforms duality and frequency shift properties to prove that Fourier transform of $e^{j\omega_0 t}$ is $2\pi\delta(\omega - \omega_0)$.

   (i) $f_8(t) = rect(\frac{t}{T})\cos(\omega_0 t)$

   (j) $f_9(t) = t[u(t-1) - u(t-5)]$

2. Find inverse Fourier transform of the following functions:

   (a) $F_1(\omega) = rect(\frac{2\omega-6\pi}{4})$

   (b) $F_2(\omega) = 3e^{-2a|\omega|}$

   (c) $F_3(\omega) = 4\cos(\tau\omega)$

   (d) $F_4(\omega) = 3\sin c(5\omega)$

3. Sketch the following functions:

   (a) $f(t) = 2 \cdot \mathrm{sinc}(\frac{2\pi t-2}{6\pi})$

   (b) $F(\omega) = rect(\frac{2\omega-6\pi}{4})$

4. A system transfer function is $H(s) = s^2 + 5s + 4$ and input signal is $x(t) = 2\cos(20\pi t)$ using the convolution property of the Fourier transform to

   (a) find the Fourier transform of the output signal $y(t)$, and

   (b) Sketch the magnitude and phase spectrum. (hint: $F(\omega) \cdot \delta(\omega - \omega_0) = F(\omega_0) \cdot \delta(\omega - \omega_0)$)

   (c) Can you tell the steady state response $y_{ss}(t)$ from the above answers and what is it?

5. Given Fourier transform of a continuous-time signal $x(t)$ is

$$X(j\omega) = \frac{A}{j\omega + p}$$

find Fourier transforms of

(a) $f(t) = 3x(2t-4)$

(b) $y(t) = \frac{d^2x(t)}{dt^2}$

(c) $w(t) = t^2x(t)$

(d) $v(t) = x(t)\cos(3t)$

(e) $q(t) = x(t) * x(t)$ where $*$ is linear convolution

6. Find the Fourier transform of the following periodic signaland show that it is equivalent

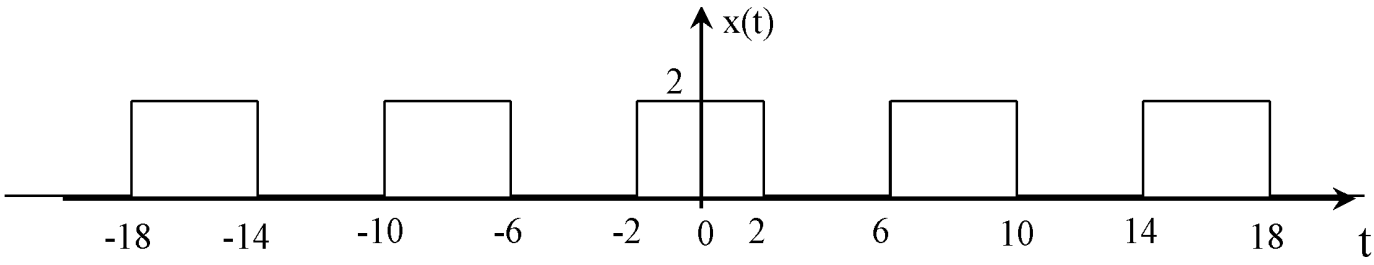

Figure 1:

to the Fourier series coefficients D_n.

7. **Extra exercise problems in the text book:** 4.6-1 and 4.6-5