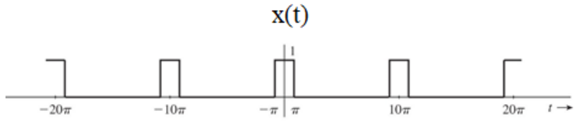
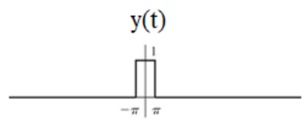
## ENGR 3323: Signals and Systems

## HW 10_Ch7

**Q1)** In previous homework you found the exponential Fourier series of $x(t)$. Find the Fourier transform of $y(t)$ and compare $X(\omega)$ to the Fourier series coefficients $D_k$.

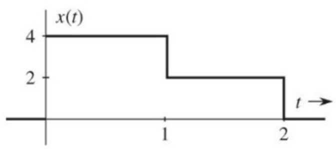


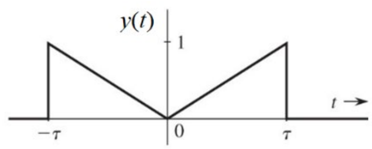




$Y(w) = 2\pi \; \text{Sinc}(w\pi)$

$D_n = w_0 \, \text{Sinc}(n w_0 \pi)$

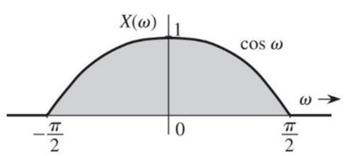
**Q2)** Find the Fourier transforms of the signals shown below using the Fourier transform integral.

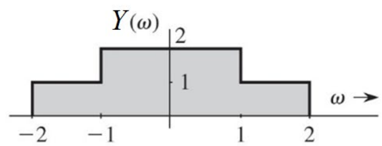



$X(w) = \dfrac{4 - 2e^{-jw} - 2e^{-j2w}}{jw}$ ; $Y(w) = \dfrac{2}{T w^2}\left[\cos wT + wT \sin wT - 1\right]$

**Q3)** Find the inverse Fourier transforms of the signals shown below using the inverse Fourier transform integral.




$x(t) = \dfrac{1}{\pi(1-t^2)} \cos\left(\dfrac{\pi t}{2}\right)$

$y(t) = \dfrac{\sin 2t + \sin t}{\pi t}$

**Q4)** Sketch the following functions:

a) rect (t/2)

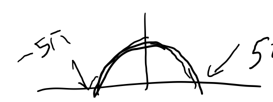
b) Δ(3ω/100)

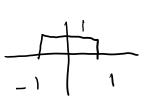
c) rect ((t − 6)/8)

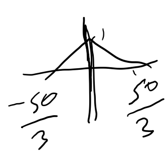
d) sinc (πω/5)

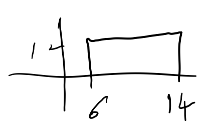
e) sinc ((ω/5) − 2π)

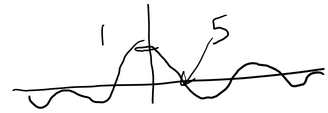
f) sinc (t/5) rect (t/10π)

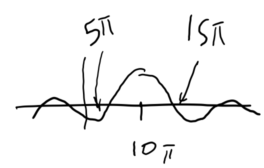


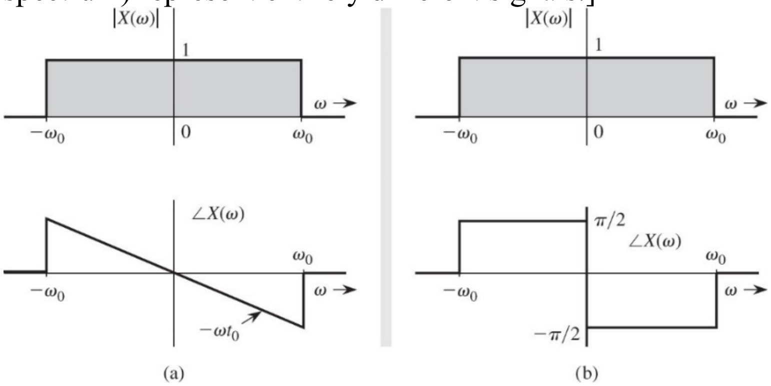



**Q5**) Find the inverse Fourier transform of $X(\omega)$ for the spectra illustrated in Figure below.
[Hint: $X(\omega) = |X(\omega)|\, e^{j\angle X(\omega)}$. This problem illustrates how different phase spectra (both with the same amplitude spectrum) represent entirely different signals.]



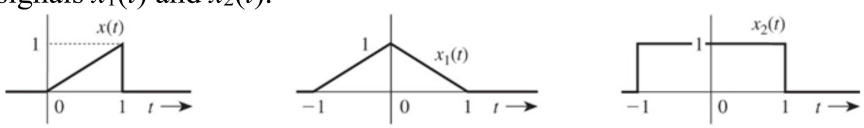

$$\rightarrow x(t) = \frac{1 - \cos \omega_0 t}{\pi t}$$

$$x(t) = \frac{W_0}{\pi} \operatorname{sinc}\left[W_0(t - t_0)\right]$$

**Q6)** The Fourier transform of the triangular pulse $x(t)$ in Figure below is expressed as

$$X(\omega) = \frac{1}{\omega^2}\left(e^{-j\omega} - j\omega e^{-j\omega} - 1\right)$$

Use this information, and the time-shifting and time-scaling properties, to find the Fourier transforms of the signals $x_1(t)$ and $x_2(t)$.




$$X_1(\omega) = X(\omega)\, e^{j\omega} + X(-\omega)\, e^{-j\omega}$$

$$X_2(\omega) = 2\left[X(2\omega)\, e^{j\omega} + X(-2\omega)\, e^{-j\omega}\right]$$