8.1

HW11 ECEN 314

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$h(t) = C\delta(t-t_0)$

If a system is distortionless then:

$$x(t) \longrightarrow \boxed{H} \longrightarrow y(t) = Cx(t-t_0)$$

H is linear so

$$y(t) = x(t) * h(t)$$

$$= x(t) * C\delta(t-t_0) = \int_{-\infty}^{\infty} x(\tau)\, h(t-\tau)\, d\tau$$

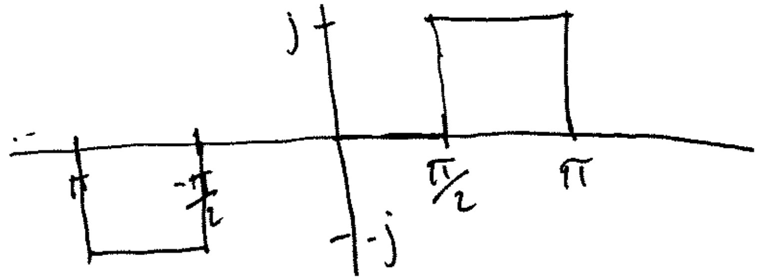
$$= \int_{-\infty}^{\infty} x(\tau)\, C\delta(t-\tau-t_0)\, d\tau$$

$$= Cx(t-t_0)$$

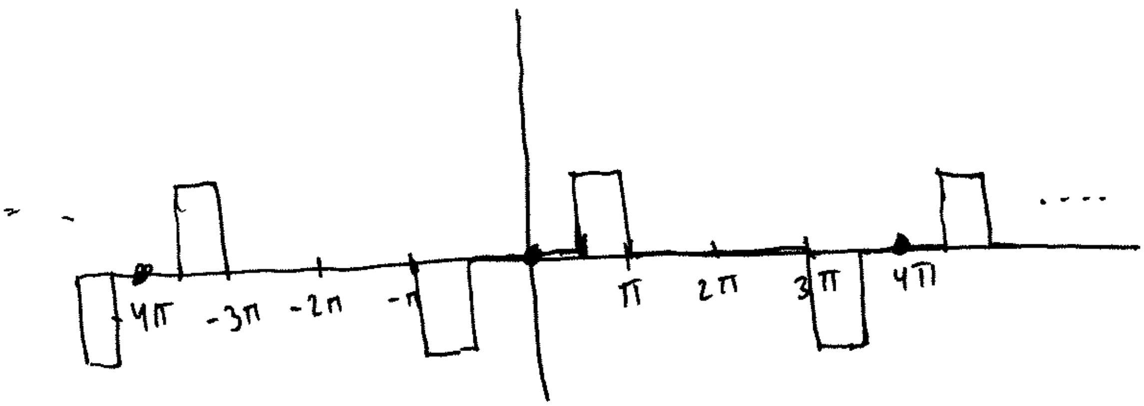
Q.E.D.

4.10

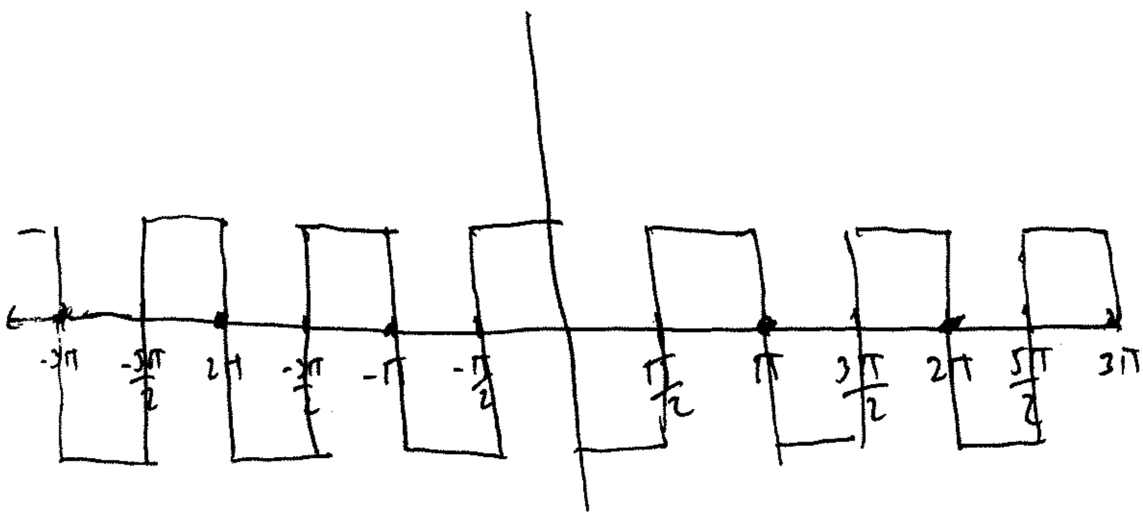
$X(j\omega)$



$T_s = \frac{1}{2}$ then $\omega_s = \frac{2\pi}{T} = \frac{2\pi}{(\frac{1}{2})} = 4\pi$



$T_s = 2$ then $\omega_s = \frac{2\pi}{2} = \pi$



4.12

a) $X(t) = \cos(\pi t) + 3\sin(2\pi t) + \sin(4\pi t)$

$\omega_1 = \pi$ $\qquad \omega_1 = 2\pi$ $\qquad \omega_3 = 4\pi$

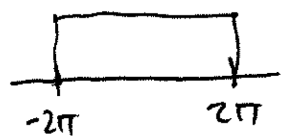
biggest ω

$\omega_s > 2\cdot 4\pi = 8\pi$

$T_s < \frac{2\pi}{\omega_s} \Rightarrow T_s < \frac{2\pi}{8\pi} = \frac{1}{4}$

b) $x(t) = \cos(2\pi t)\frac{\sin \pi t}{\pi t} + 3\sin(6\pi t)\frac{\sin(2\pi t)}{\pi t}$

$X(j\omega) = \left(\pi\delta(\omega - 2\pi) + \pi\delta(\omega + 2\pi)\right) *$ 

$+ \frac{3\pi}{j}\left(\delta(\omega - 6\pi) - \delta(\omega + 6\pi)\right) *$ 

$\omega_s > 2\cdot 8\pi$

$T_s < \frac{2\pi}{2\cdot 8\pi} = \frac{1}{8}$

c) $\omega_s > \cancel{2}\cdot\frac{9\pi}{\cancel{2}}$

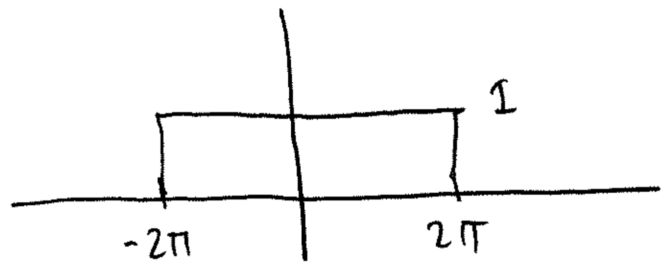
$T_s < \frac{2\pi}{9\pi} = \frac{2}{9}$

4.25

a)

$$x(t) = \frac{1}{\pi t} \sin(2\pi t)$$

$X(j\omega) =$



$$T_s = \frac{1}{8} \Rightarrow \omega_s = \frac{2\pi}{\left(\frac{1}{8}\right)} = 16\pi$$

$X_s(j\omega) =$