

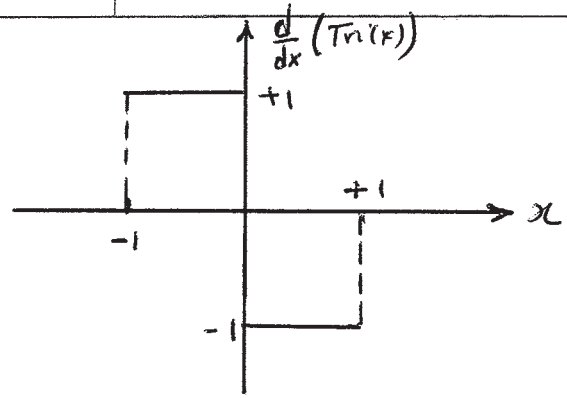
Problem 3) a)  $\frac{d}{dx} \text{Tri}(x) = f(x)$

$$F(s) = \int_{-\infty}^{\infty} f(x) e^{-i2\pi s x} dx =$$

$$\int_{-1}^0 e^{-i2\pi s x} dx - \int_0^1 e^{-i2\pi s x} dx =$$

$$\frac{1}{-i2\pi s} e^{-i2\pi s x} \Big|_{-1}^0 - \frac{1}{-i2\pi s} e^{-i2\pi s x} \Big|_0^1 = \frac{1 - e^{i2\pi s}}{-i2\pi s} + \frac{e^{-i2\pi s} - 1}{i2\pi s}$$

$$= \frac{-2 + 2 \cos(2\pi s)}{i2\pi s} = \frac{\cos(2\pi s) - 1}{i\pi s} = \frac{(1 - 2\sin^2(\pi s)) - 1}{i\pi s} = -\frac{2 \sin^2(\pi s)}{i\pi s}$$



b)  $g(x) = \int_{-\infty}^{\infty} G(s) e^{+i2\pi s x} ds \Rightarrow g'(x) = \int_{-\infty}^{\infty} i2\pi s G(s) e^{+i2\pi s x} ds \Rightarrow$

$$\mathcal{F}\{g'(x)\} = i2\pi s G(s).$$

We know from part (a) that  $\mathcal{F}\{\text{Tri}'(x)\} = -\frac{2 \sin^2(\pi s)}{i\pi s}$ . Therefore,

$$\mathcal{F}\{\text{Tri}'(x)\} = -\frac{\frac{2 \sin^2(\pi s)}{i\pi s}}{i2\pi s} = -\frac{2 \sin^2(\pi s)}{2i^2(\pi s)^2} = \left(\frac{\sin \pi s}{\pi s}\right)^2 = \text{Sinc}^2(\pi s).$$