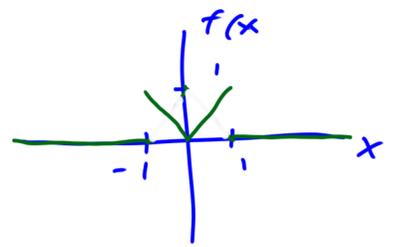


11.9.9

$$f(x) = \begin{cases} |x| & -1 < x < 1 \\ 0 & \text{otherwise} \end{cases}$$



find $F(\omega)$

$$F(\omega) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\infty} f(x) e^{-i\omega x} dx$$

$$= \frac{1}{\sqrt{2\pi}} \left(\int_{-1}^0 -x e^{-i\omega x} dx + \int_0^1 x e^{-i\omega x} dx \right)$$

$$\int x e^{ax} dx = \int u dv = uv - \int v du$$

$$\begin{aligned} u &= x & du &= dx \\ dv &= e^{ax} dx & v &= \frac{e^{ax}}{a} \end{aligned}$$

$$= \frac{x e^{ax}}{a} - \int \frac{e^{ax}}{a} dx$$

$$= \frac{x e^{ax}}{a} - \frac{e^{ax}}{a^2}$$

$$\begin{aligned} (-i\omega)^2 \\ -\omega^2 \end{aligned}$$

$$= \frac{1}{\sqrt{2\pi}} \left(-\frac{x e^{-i\omega x}}{-i\omega} + \frac{e^{-i\omega x}}{-\omega^2} \Big|_{-1}^0 + \frac{x e^{-i\omega x}}{-i\omega} - \frac{e^{-i\omega x}}{-\omega^2} \Big|_0^1 \right)$$

$$= \frac{1}{\sqrt{2\pi}} \left(\frac{1}{-\omega^2} - \frac{e^{i\omega}}{-i\omega} - \frac{e^{i\omega}}{-\omega^2} + \frac{e^{-i\omega}}{-i\omega} - \frac{e^{-i\omega}}{-\omega^2} + \frac{1}{-\omega^2} \right)$$

$$= \frac{1}{\sqrt{2\pi}} \left(\frac{-2}{\omega^2} + \frac{e^{i\omega} - e^{-i\omega}}{i\omega} + \frac{e^{i\omega} + e^{-i\omega}}{\omega^2} \right)$$

$$= \frac{1}{\sqrt{2\pi}} \left(\frac{e^{i\omega} + e^{-i\omega} - 2}{\omega^2} + \frac{e^{i\omega} - e^{-i\omega}}{i\omega} \right)$$

Energy spectral density $|F(\omega)|^2$

$|F(\omega)|$

$\angle F(\omega)$