

Problem S15 (Signals and Systems)

Find the Fourier transforms of the following signals:

1.

$$g(t) = \delta(t - T)$$

Note: The system with impulse response $g(t)$ produces an output that is the input delayed by T . Since delays occur frequently in signal processing, $G(j\omega)$ is an important transfer function.

2.

$$g(t) = \begin{cases} 1, & |t| \leq T \\ 0, & |t| > T \end{cases}$$

Note: Because $g(t)$ is symmetric, $G(j\omega)$ should be real. Please express your answer so that it is apparent that the answer is real.

3.

$$g(t) = \frac{1}{t^2 + T^2}$$

Hint: If you find the integral hard to do, you might be able to find the answer using duality.

4.

$$g(t) = \frac{\sin \pi t/T}{\pi t/T}$$

Hint: You almost certainly won't be able to do the FT integral directly. Use duality and the results of (2) above to find the answer. The $g(t)$ in this problem has important connections to, among other things, CD players!

5. Find the inverse transform of

$$G(j\omega) = \left(\frac{\sin \omega T}{\omega T} \right)^2$$

using the results of part (2), and FT properties.