

COMMUNICATION THEORY, Class Exercise 1, Fall 2023

1. Derive the fundamental Fourier theorems or properties presented below.

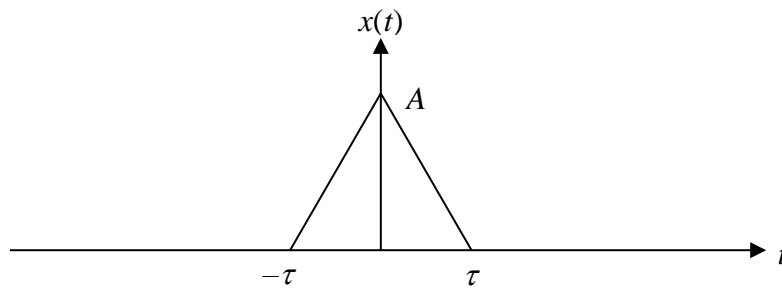
Time delay: $x(t - t_d) \xrightarrow{\mathcal{F}} X(f)e^{-j2\pi f t_d}$

Frequency conversion: $x(t)e^{j2\pi f_c t} \xrightarrow{\mathcal{F}} X(f - f_c)$

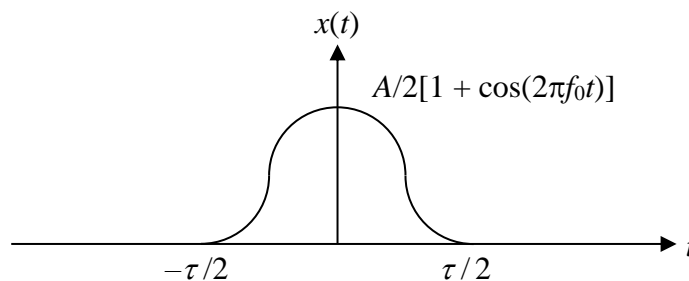
Differentiation: $\frac{d}{dt}x(t) \xrightarrow{\mathcal{F}} j2\pi f X(f)$

Multiplication: $x(t)y(t) \xrightarrow{\mathcal{F}} X(f) * Y(f)$

2. Derive the Fourier transform of the following finite-energy signal and sketch its spectrum.



3. Derive the Fourier transform of the following finite-energy signal and sketch its spectrum.



4. Derive the Fourier transform of the following impulse train and sketch its spectrum.

