ME 5224: Signals and Signals

Spring: 2023

Instructor: Dr. I-Fan Lin

Homework 8 - System Analysis with the CTFT

Spring 2023

Exercise 1. Convolution and CTFTs

For each of the following, calculate $X(\omega),\,Y(\omega),\,Z(\omega)=X(\omega)Y(\omega),$ and z(t).

$$\begin{split} \text{(a)} \ \, x(t) &= e^{-t} u(t) \text{ and } y(t) = e^{-t} u(t) \\ X(\omega) &= \int_{-\infty}^{\infty} x(t) e^{-j\omega t} dt = \int_{-\infty}^{\infty} e^{-t} u(t) e^{-j\omega t} dt = \int_{0}^{\infty} e^{-t(1+j\omega)} dt = \frac{-e^{-t(1+j\omega)}}{1+j\omega} \bigg|_{0}^{\infty} = \frac{1}{1+j\omega} \\ Y(\omega) &= \frac{1}{1+j\omega}, \quad Z(\omega) = X(\omega) Y(\omega) = \frac{1}{(1+j\omega)^2} \\ z(t) &= x(t) * y(t) = \int_{-\infty}^{t} e^{-\tau} u(\tau) e^{-(t-\tau)} u(t-\tau) d\tau = \int_{0}^{t} e^{-t} d\tau = t e^{-t} u(t) \end{split}$$

[Not Finished]