

EE301 Homework #11

Problem 1 Inverse CTFT's

Calculate the inverse CTFT's of the following transforms.

(a) $X(\omega) = \frac{1}{j\omega+5}$

(b) $X(\omega) = \frac{1}{(j\omega+5)^2}$

(c) $X(\omega) = \frac{1}{(j\omega+5)(j\omega+2)}$

Problem 2 Convolution and CTFT's

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

(a) $x(t) = e^{-t}u(t)$ and $y(t) = e^{-t}u(t)$

(b) $x(t) = (e^{-t}u(t)) * (e^{-t}u(t))$ and $y(t) = e^{-t}u(t)$

(c) $x(t) = \frac{t^{n-1}}{(n-1)!}e^{-t}u(t)$ and $y(t) = e^{-t}u(t)$

(d) $x(t) = e^{-t}u(t)$ and $y(t) = e^{-2t}u(t)$

(e) $x(t) = e^{-t}u(t)$ and $y(t) = te^{-2t}u(t)$

Problem 3 Sampling and CTFT's

Consider the functions

$$y(t) = x(t) \sum_{k=-\infty}^{\infty} \delta(t - kT)$$

For each signal below, i) sketch $x(t)$, ii) calculate $X(\omega)$, iii) sketch $X(\omega)$, iv) sketch $y(t)$, v) calculate $Y(\omega)$, vi) sketch $Y(\omega)$, vii) indicate if there is aliasing.

(a) $x(t) = \text{sinc}(t)$ and $T = 1/2$.

(b) $x(t) = \text{sinc}(t)$ and $T = 1$.

(c) $x(t) = \text{sinc}(t)$ and $T = 3/2$.

(d) $x(t) = \cos(2\pi t)$ and $T = 1/4$.

(e) $x(t) = \cos(2\pi t)$ and $T = 3/4$.

Problem 4 *Sampling and reconstruction*

Consider a sampling system

$$y(t) = x(t) \sum_{k=-\infty}^{\infty} \delta(t - kT)$$

where $T = 1$ and $x(t)$ is a function that is band-limited to $|\omega| < \pi$. Then, consider the signal

$$z(t) = y(t) * h(t)$$

where $h(t) = \text{sinc}(t)$.

- (a) Determine $Y(\omega)$ in terms of $X(\omega)$.
- (b) Sketch $Y(\omega)$ for a typical function $X(\omega)$.
- (c) Determine and sketch $H(\omega)$.
- (d) Determine $Z(\omega)$ in terms of $X(\omega)$.
- (e) Sketch $Z(\omega)$ for a typical function $X(\omega)$.
- (f) Determine $z(t)$ in terms of $x(t)$.