Principles of communication systems

EET3202, CUNY City Tech, Fall 2023

Homework #02 (Due on Sep 14)

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Problem 1

Part 1: From the definition of Fourier transform, prove that $g(-t) \overset{\mathcal{F}}{\longleftrightarrow} G(-f)$

Part 2: Find the Fourier transform of $e^{-at}u(t)$

Part 3: Use parts 1 and 2 to find the Fourier transform of $e^{at}u(-t)$ and $e^{-a|t|}$.

Problem 2

Fourier transform of the sign function sgn(t) $= \begin{cases} 1 & t > 0 \\ 0 & t = 0 \\ -1 & t < 0 \end{cases}$

Hint: you can instead calculate the Fourier transform of $f_a(t) = e^{-at}u(t) - e^{at}u(-t)$

That is because $\operatorname{sgn}(t) = \lim_{a \to 0} f_a(t)$

Finally calculate $\lim_{a \to 0} \mathcal{F}[f_a(t)]$

Problem 3

Find the Fourier transform of the following function.

$$g(t) = e^{-a|t-t_0|}$$

Hint: use the result of problem 1 part 3 as well as the "Time-Shifting" property of Fourier Transform.

Problem 4

Plot the amplitude and phase of the following Fourier function vs frequency.

$$G(f) = \frac{1}{j 2\pi f}$$