12/10

King Fahd University of Petroleum & Minerals
Electrical Engineering Department
EE207: Signals & Systems (122)
Quiz 5: Fourier Transform and Applications
Dr. Ali Hussein Muqaibel

Serial # ...

-1 points for not writing your serial #

Name: KEY

Tables are attached

Using the duality property, find the Fourier Transform of $\delta(t+t_0)+\delta(t-t_0)$ (Cleary detail your steps) **(5 points)**

We know that:

$\cos(\omega_0 t) \longleftrightarrow \pi[\delta(\omega+\omega_0)+\delta(\omega-\omega_0)]$

By duality:

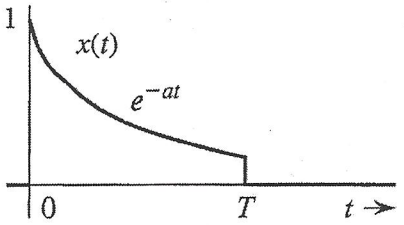
$F(t) \longleftrightarrow 2\pi f(-\omega)$

$\therefore \pi[\delta(t+t_0)+\delta(t-t_0)] \longleftrightarrow 2\pi \cdot \cos(-\omega t_0)$

$\therefore \delta(t+t_0)+\delta(t-t_0) \longleftrightarrow 2\cos(\omega t_0)$

Since cosine is an even function

Using the definition, find the Fourier transform for the signal shown in the Figure **(5 points)**



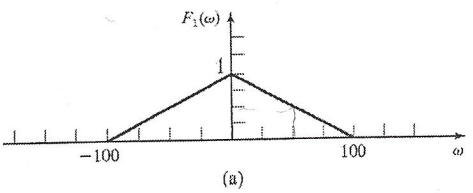
$$F(\omega) = \int_{-\infty}^{\infty} f(t)\, e^{-j\omega t}\, dt$$

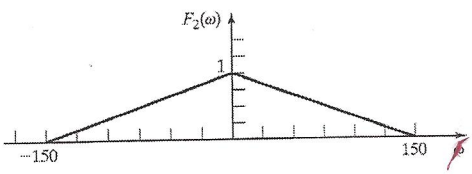
$$F(\omega) = \int_0^T e^{-at} e^{-j\omega t}\, dt$$

$$F(\omega) = \frac{e^{t(-a-j\omega)}}{-a-j\omega}\Bigg|_0^T$$

$$F(\omega) = \frac{e^{T(-a-j\omega)}}{-a-j\omega} + \frac{1}{a+j\omega} = \frac{1}{a+j\omega}\left[1 - e^{-T(a+j\omega)}\right]$$

The spectrum of two signals are shown in the Figure, write the relationship between the two signals in the time domain. *i.e. write the relation between $f_1(t)$ and $f_2(t)$.* **Bonus (0 or +2)**





We know that if

$f(t) \longleftrightarrow F(\omega)$ then

$f(at) \longleftrightarrow \frac{1}{|a|} F\left(\frac{\omega}{a}\right)$

Clearly,

$F_2(\omega) = F_1\left(\frac{\omega}{1.5}\right)$

$\therefore f_1(1.5t) \longleftrightarrow \frac{1}{1.5} F_1\left(\frac{\omega}{1.5}\right)$

$\therefore 1.5 f_1(1.5t) \longleftrightarrow F_1\left(\frac{\omega}{1.5}\right)$

$\therefore f_2(t) \longleftrightarrow F_2(\omega)$

$\therefore f_2(t) = 1.5 f_1(1.5t)$

Good luck, Dr. Ali Muqaibel