ECE 3337: Signals & Systems Analysis, Class Worksheet 21

The purpose of this worksheet is to develop familiarity with the Fourier transform by deriving a set of transforms that are listed in Table 5-6 of your textbook. Please derive the following forward and inverse Fourier transforms. The correct answers are in Table 5-6, so your goal should be to practice your ability to perform these derivations correctly.

1. (50 points) Calculate the Fourier transforms for the following signals:

$x_1(t) = \delta(t - T)$

$x_2(t) = \text{rect}\left(\frac{t}{\tau}\right)$

$x_3(t) = te^{-at}u(t)$

$x_4(t) = \cos(\omega_0 t)u(t)$

$x_5(t) = e^{-at}\cos(\omega_0 t)u(t)$

2. (50 points) Calculate the inverse Fourier transforms for the following signals:

$\hat{\mathbf{X}}_1(\omega) = 1$

$\hat{\mathbf{X}}_2(\omega) = \pi\delta(\omega) + \frac{1}{j\omega}$

$\hat{\mathbf{X}}_3(\omega) = \frac{1}{a - j\omega}$

$\hat{\mathbf{X}}_4(\omega) = j\pi[\delta(\omega + \omega_0) - \delta(\omega - \omega_0)]$

$\hat{\mathbf{X}}_5(\omega) = \frac{\omega_0}{(a + j\omega)^2 + \omega_0^2}$