DSP Homework 03

1. Write a summary of this week's video(s) and your further thoughts on the content.
2. Do a campus survey to meaningfully answer the following questions:
   - When is an average undergraduate student most or least happy during a day.
   - When is an average undergraduate student most or least happy in a particular day of the week?

   Then, based on your survey,

   (a) Write an article on what the school can do to make the students' campus life more suitable for them?
   (b) Explore other meaningful results from your data.
   (c) Propose ways to teach computers to get similar results automatically.
3. The Fourier transform pair can be defined as

$$\tilde{x}(f) = \int_{-\infty}^{\infty} x(t) e^{-j2\pi ft} dt \tag{1}$$

$$x(t) = \int_{-\infty}^{\infty} \tilde{x}(f) e^{j2\pi ft} df \tag{2}$$

   Prove the following

(1)	$ax(t) + by(t)$	$\leftrightarrow$	$a\tilde{x}(f) + b\tilde{y}(f)$	Linearity
(2)	$x(st)$	$\leftrightarrow$	$\frac{1}{\lvert s\rvert}\tilde{x}(\frac{f}{s})$	Scaling
(3)	$x^*(t)$	$\leftrightarrow$	$\tilde{x}^*(-f)$	Conjugate
(4)	$\tilde{x}(t)$	$\leftrightarrow$	$x(-f)$	Duality
(5)	$x(t - t_0)$	$\leftrightarrow$	$e^{-j2\pi t_0 f}\tilde{x}(f)$	Time shift
(6)	$e^{j2\pi f_0 t}x(t)$	$\leftrightarrow$	$\tilde{x}(f - f_0)$	Frequency shift
(7)	$x'(t)$	$\leftrightarrow$	$j2\pi f\tilde{x}(f)$	Differentiation
(8)	$\int x(\tau)y(t - \tau)d\tau$	$\leftrightarrow$	$\tilde{x}(f)\tilde{y}(f)$	Convolution