

**Homework assignment 2**Due date: March 29, 2016

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1. Prove the scaling property of Fourier transform: if the Fourier transform of the signal  $x(t)$  is  $X(f)$ , then the Fourier transform of  $x(a \cdot t)$  is  $\frac{1}{a} \cdot X(f/a)$ , where  $a > 0$  is a constant.
2. Let  $x(t)$  and  $y(t)$  be two signals, whose Fourier transforms are  $X(f)$  and  $Y(f)$ , respectively. Find Fourier transforms of the following signals:

(a)

$$2 \cdot x(t) \cdot \cos(2\pi f_0 t) + 3 \cdot y(t - \pi/2) ;$$

(b)

$$x(t - b) \star y(t + b) ,$$

where  $b$  is a constant.Hint: there is no need to perform integration.

3. (a) Find Fourier transform of the following signal:

$$x(t) = \begin{cases} 0 & \text{if } t < 1 \\ A & \text{if } 1 \leq t \leq 2 \\ 0 & \text{if } t > 2 \end{cases} ,$$

where  $A$  is some constant.

- (b) Write MATLAB code, which applies Fourier Transform algorithm (FFT) to  $x(t)$  and obtains  $X(f)$ . Show plots of  $x(t)$  and of  $X(f)$ .
4. For each of the following signals determine if they are energy signals, power signals, or neither:

(a)

$$x(t) = \frac{1}{2} ;$$

(b)

$$x(t) = \begin{cases} 0 & \text{if } t < 1 \\ \frac{1}{t^2} & \text{if } t \geq 1 \end{cases} .$$