Tutorial 3

1. Determine the complex exponential Fourier series representation for each of the following signals:

   (a) $x(t) = \cos(\omega_0 t)$

   (b) $x(t) = \cos(2t + \frac{\pi}{4})$

   (c) $x(t) = \cos 4t + \sin 6t$

   (d) $x(t) = \sin^2(t)$

2. Consider the following continuous sinusoid

$$x(t) = 2\cos(2\pi 100 t)$$

   (a) Compute the fundamental frequency and fundamental period of $x(t)$.

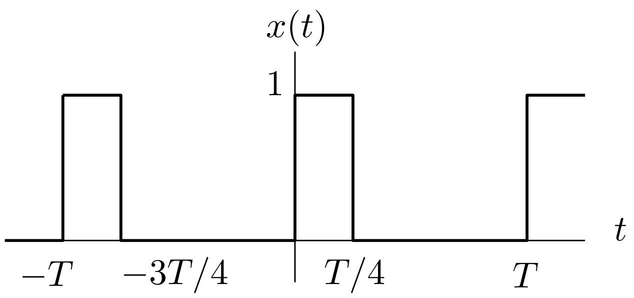
   (b) Compute the power of $x(t)$.

   (c) Using Euler's formula, express $x(t)$ in complex exponential functions.

   (d) From 2c, determine the continuous-time Fourier series representation of $x(t)$.

   (e) Plot the magnitude and phase of the continuous-time Fourier series coefficients of $x(t)$.

3. Determine the Fourier series of the periodic square wave shown in the following figure



4. Find the Fourier transform of the signal

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

   where $a > 0$.

5. The FT pair of the unit rectangle signal is given by

$$x(t) = \text{rect}(t) = \begin{cases} 1 & |t| \le 1/2 \\ 0 & \text{otherwise} \end{cases} \longleftrightarrow X(\omega) = \frac{\text{sin}(\omega/2)}{\omega/2}$$

(See Lecture 6 for the derivation). Now express the following signals in terms of time-shifted and -scaled version of the unit rectangle signal, and then apply the FT properties (i.e., time shifting and time scaling properties) to evaluate the FT for the following signals.

(a) $x_1(t) = \begin{cases} 1 & -1 \le t \le 0 \\ -1 & 0 \le t \le 1 \\ 0 & \text{otherwise} \end{cases}$

(b) $x_2(t) = u(t) - u(t-1)$

(c) $x_3(t) = u(t) - u(t-2)$