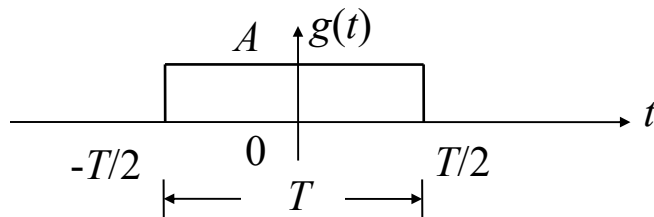


EE 3008. Fourier Transform Tutorial Questions

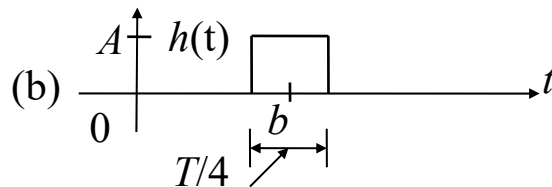
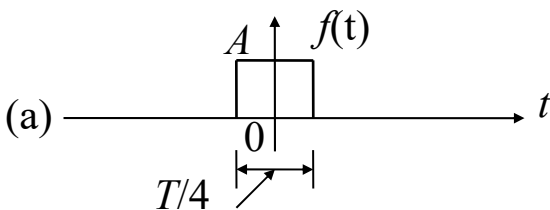
Q1) The Fourier transform (also called the spectrum) of $x(t)$ is defined as

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

Find the Fourier transform of the following function. Draw its magnitude.

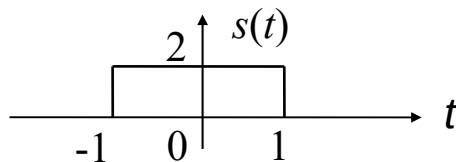


Q2) Draw the magnitude of the Fourier transform of the following two functions.



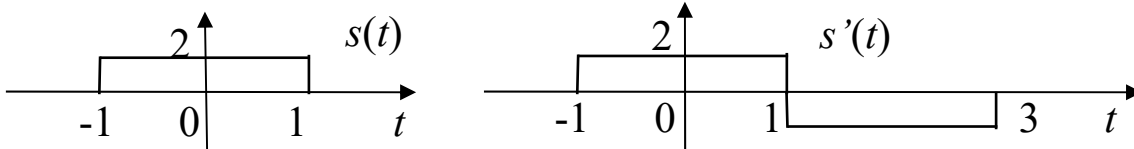
Note that part (a) is related to the scaling property and part (b) is related to time shift property

Q3) (a) What is the magnitude spectrum of the signal $s(t)$ in the following figure. What is the first zero in the spectrum?

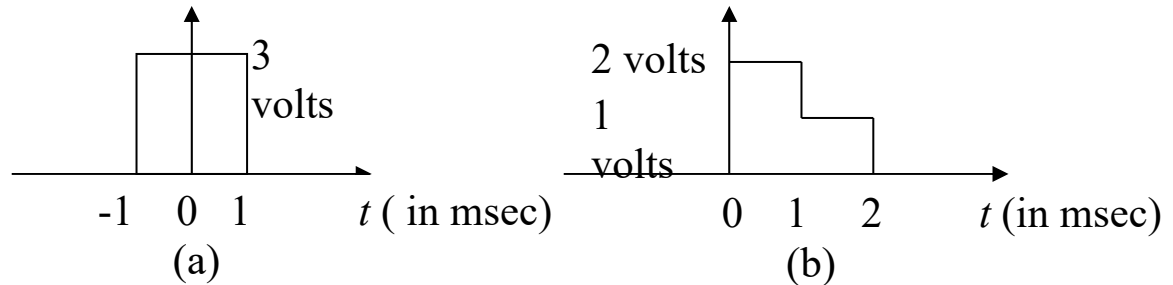


(b) Find the spectrum of $s'(t) = s(t-2)$. What is the first zero now?

Q4) Let $s(t)$ and $s'(t)$ be defined below. Find the spectrum of $s'(t)$. Where is the first zero in the spectrum of $s'(t)$?



Q5) Determine the frequency domain expression for the two waveforms below. If you have a good programming skill, you may draw their magnitude spectrum and energy spectra using a computer.



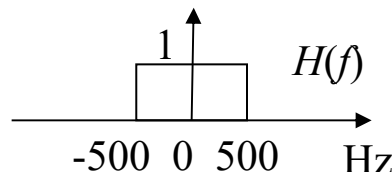
Q6) The following questions are designed to illustrate the use of the Fourier properties.

- (1) Determine the Fourier transform of 2.
- (2) Determine the Fourier transforms of $\sin(2\pi f_0 t)$ and $\cos(2\pi f_0 t)$.
- (3) Let $X(f)$ be the Fourier transform of $x(t)$. Determine the time domain function whose Fourier transform is $X(f-f_0)$.
- (4) Let $X(f)$ be the Fourier transform of $x(t)$. Determine the Fourier transforms of $x(t)\sin(2\pi f_0 t)$ and $x(t)\cos(2\pi f_0 t)$.

(5) Find the Fourier transform of $\frac{2 \sin(6\pi t)}{\pi t}$.

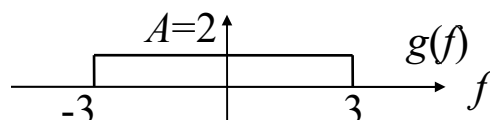
(6) What is the name of a device whose impulse response is the function given in (5).

Q7) Suppose that the waveform in Q5(b) is passed through a filter with transfer function shown below. Draw the magnitude spectrum at the filter's output.



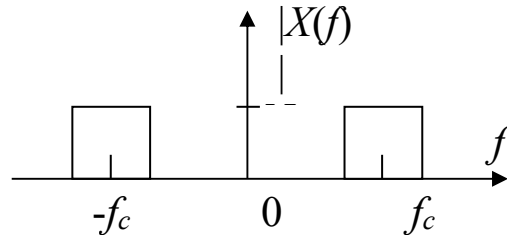
Note that this question is on the basic principle of low-pass filtering.

Q8) In practice, is it possible to realize a pulse with the spectrum shown below.



Q9) Prove the symmetry property $|X(f)|^2 = |X(-f)|^2$ for a real function $x(t)$.

Q10) Suppose that $x(t)$ is real and its magnitude spectrum is given below.

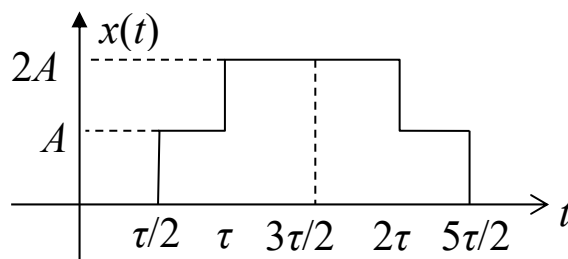


(1) Determine the magnitude spectrum of $x(t-t_0)$. Is it symmetric to the y -axis? Why?

(2) Determine the magnitude spectrum of $x(t)e^{j2\pi fct}$. Is it symmetric to the y -axis? Why?

Q11) Find the Fourier transform of $s(t) = Ce^{j2\pi f_0 t}$.

Q12) Express the Fourier transform of the signal shown below in terms of *sinc* functions.



Q13) Let $X(f)$ be the Fourier transform of $x(t)$, as shown below. Please

find: (a) $x(t)$ and (b) $\int_{-\infty}^{+\infty} x(t)dt$

