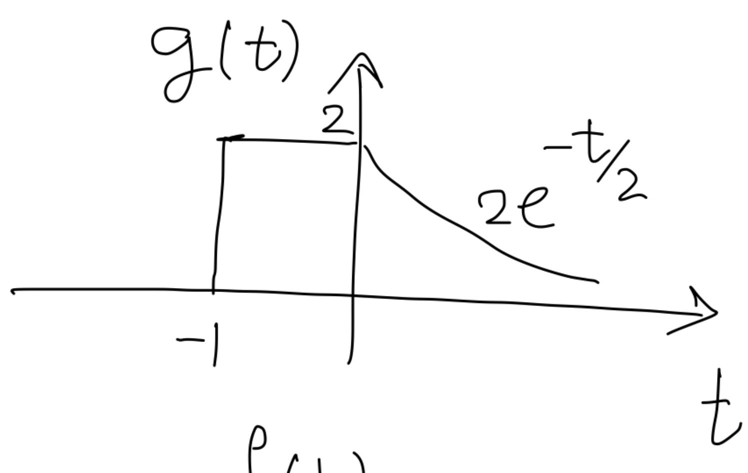
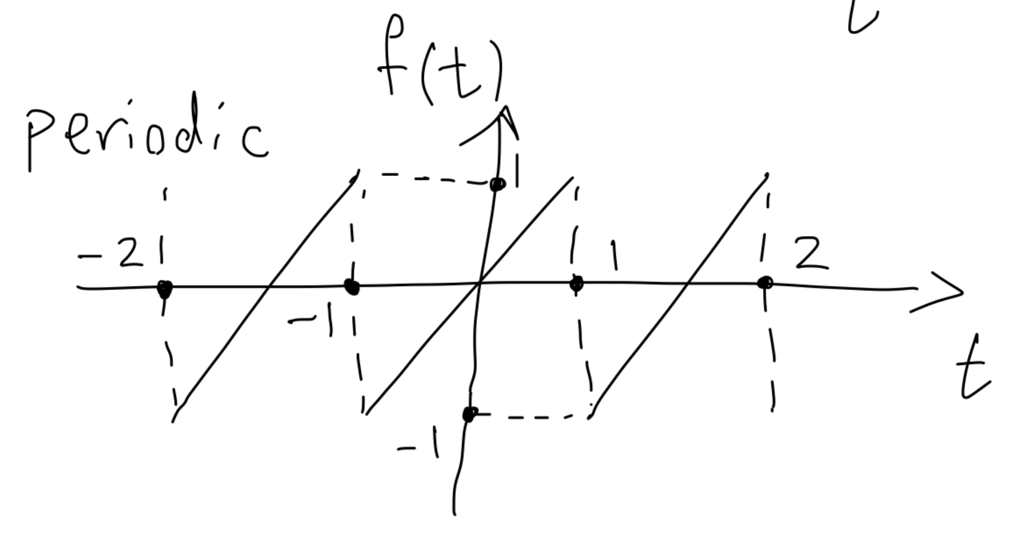
EET3202
Principles of Communications Systems
Fall 2023
CUNY City Tech

Homework 1

1. Calculate the energy and power of the signals below.





2. Prove the following for the impulse function.

$$\delta(at) = \frac{1}{|a|}\delta(t)$$

Start by evaluating

$$\int_{-\infty}^{\infty} f(t)\,\delta(at)\,dt$$

and then argue the conclusion.

3. Construct the single-sided and double-sided spectrum of the following signal:

$$v(t) = -3 - 4\sin(30\pi t)$$

* plot both amplitude and phase

4. Two signals are called orthogonal if their "inner product" is zero. The inner product for signals f(t) and g(t) is defined as

$$\langle f, g\rangle = \int_{t_1}^{t_2} f(t)g(t)\,dt$$

where t_1 and t_2 are arbitrary.
Show that any two different exponentials in the Fourier Series are orthogonal.
For instance if $v_n(t) = e^{j2\pi n f_0 t}$ and $v_m(t) = e^{j2\pi m f_0 t}$, show that
$\langle v_n, v_m\rangle = 0$

5. Let's assume v(t) is a real signal with the following Fourier Series.

$$v(t) = \sum_{n=-\infty}^{\infty} C_n e^{j2\pi n f_0 t}$$

Show that if v(t) is a real function, then the Fourier Series can be modified to

$$v(t) = C_0 + \sum_{n=1}^{\infty} 2|C_n|\cos(2\pi n f_0 t + \arg C_n)$$

where $C_n = |C_n| e^{j(\arg C_n)}$

amplitude of C_n — phase of C_n

6. plot $\text{Sinc}\,\lambda = \dfrac{\sin \pi\lambda}{\pi\lambda}$ as a function of λ.

Then plot $\text{Sinc}\left(\frac{n}{4}\right) = \dfrac{\sin \pi n/4}{\pi n/4}$ as a function of n which is an integer number.