# ELC225B Signals and Systems Report

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## 1 Main Information

The code is written in the Python programming language, using the NumPy library for simple mathematical operations and the matplotlib library for plotting the figures. The input resolutions used for the figures are chosen per the document when indicated, and for convenience otherwise. Each part has its own file (for example, "PartA.py") which imports its needed functions from "main.py" and uses them to draw the figures.

## 2 Part A

Included are the unit step function, the rect function, the triangl function, and the part (c) and (d) functions.

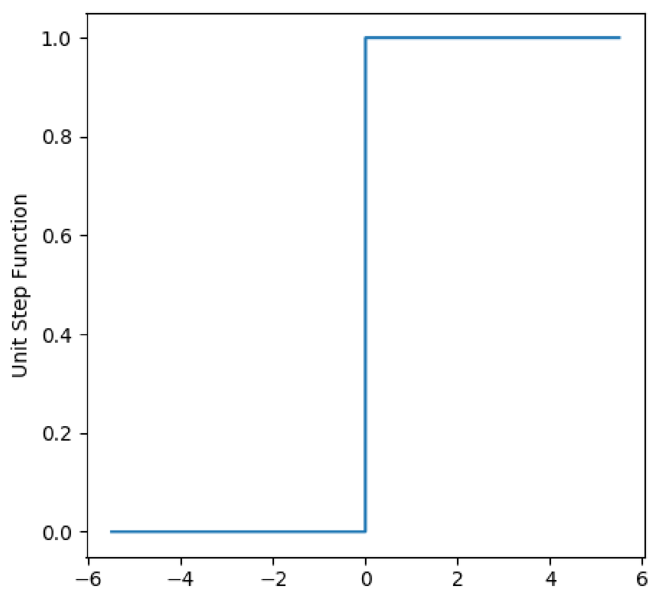


Figure 1: Unit Step Function

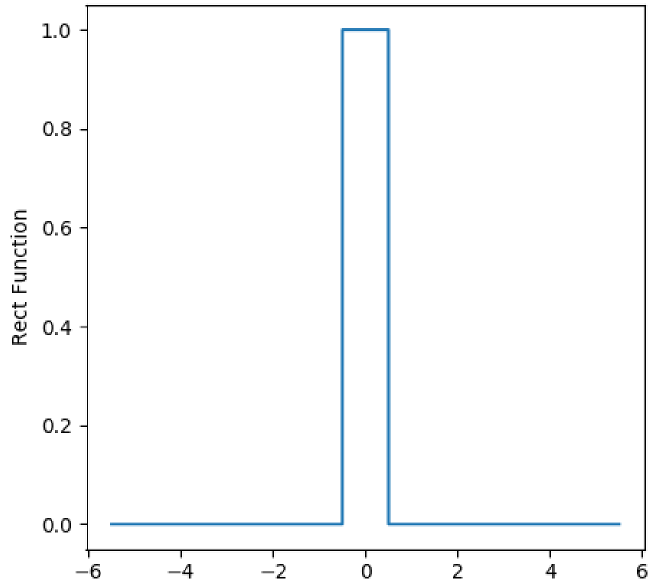


Figure 2: Rect Function

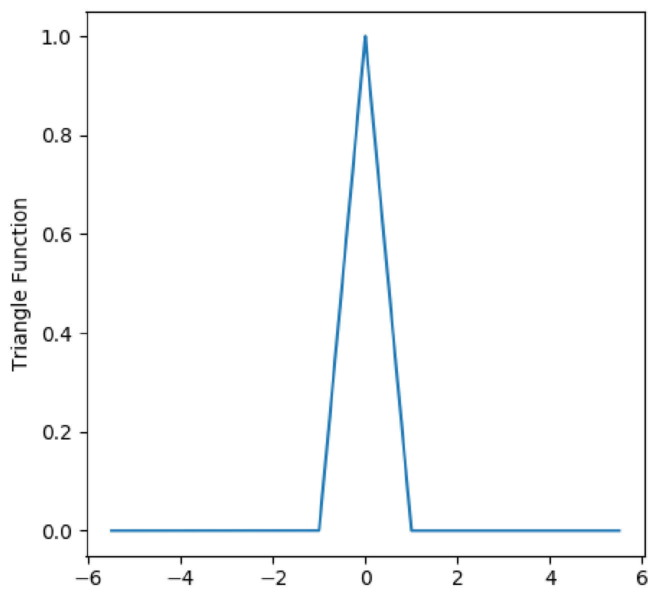


Figure 3: Triangl Function

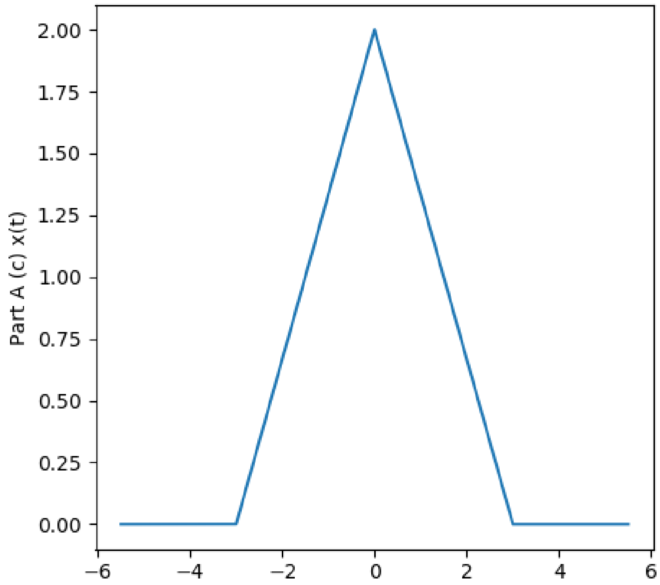


Figure 4: Part (A) (c) Function

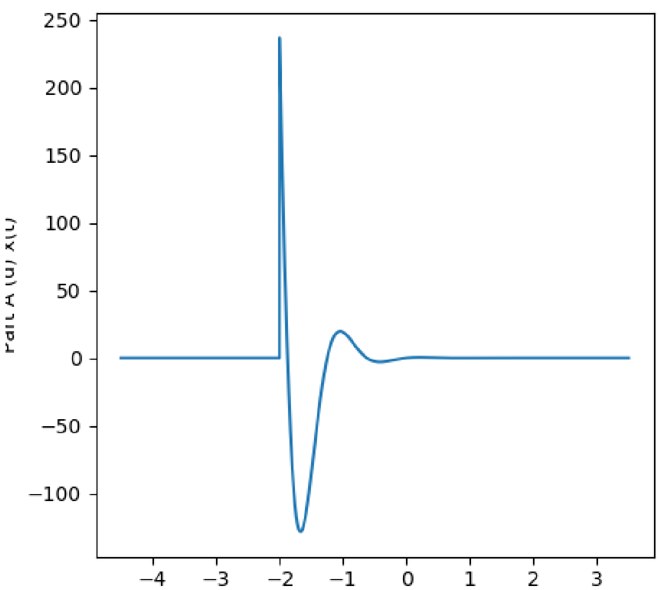


Figure 5: Part (A) (d) Function

# 3 Part B

Included are the four functions from Part (B).

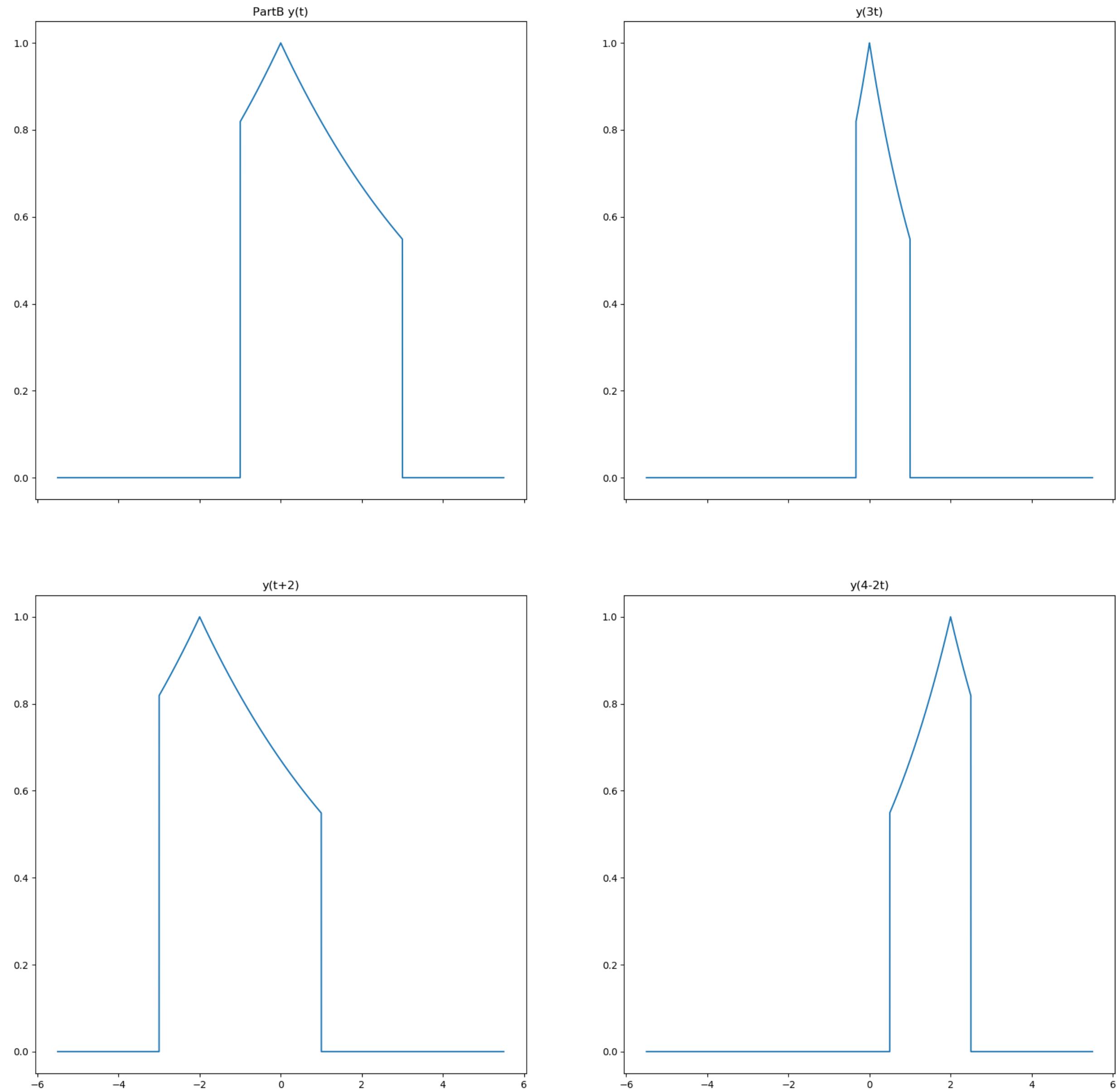


Figure 6: Part (B) Functions

# 4 Part C

The function from part C:

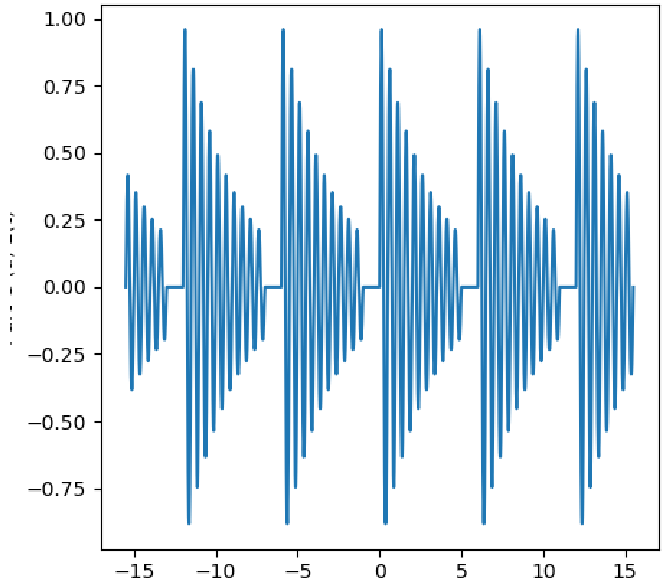


Figure 7: Part (C) (a) Function

The energy of the signal is infinite (as it is a periodic signal). The average power is

$$\frac{1}{6}\int_0^5 \left\| e^{-\frac{\|t\|}{3}} \sin(4\pi t) \right\|^2 dt = \frac{18(-1+e^{\frac{10}{3}})\pi^2}{e^{\frac{10}{3}}(1+144\pi^2)} \simeq 0.120456$$

# 5 Part D

Included are $h(t)$, the fourier series magnitudes and phases. Please note that the phase is very small (almost zero, on the order of $10^{-12}$ and it might be an artifact of numerical approximation.

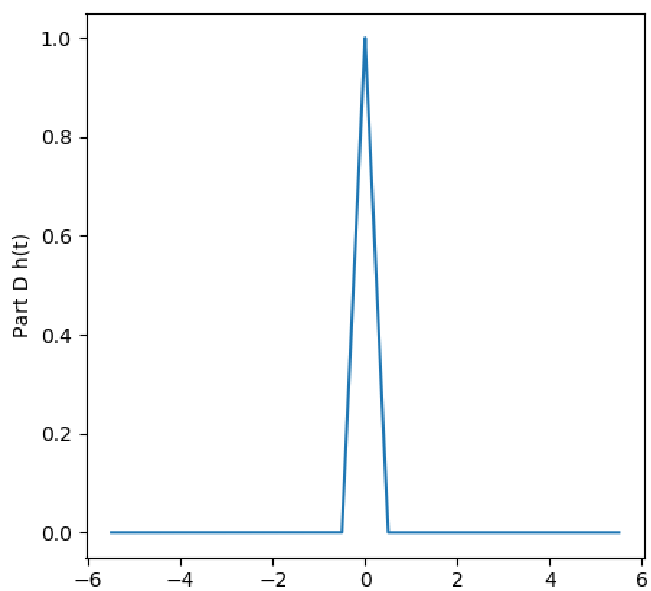


Figure 8: Part (D) $h(t)$

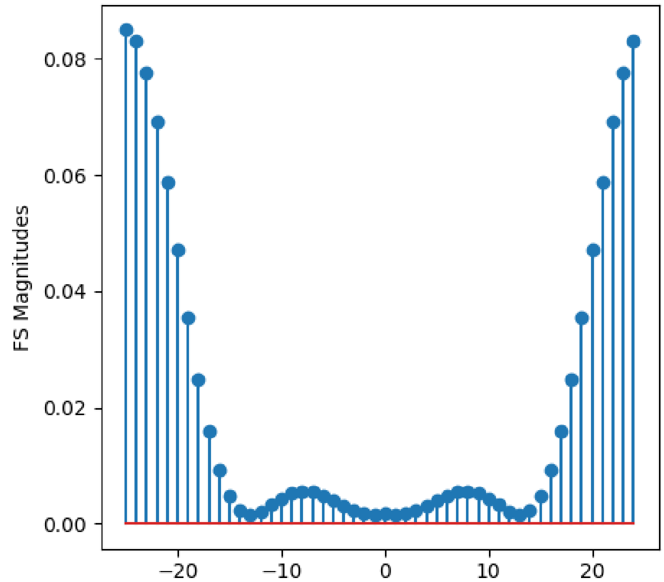


Figure 9: $h(t)$ fourier series magnitudes

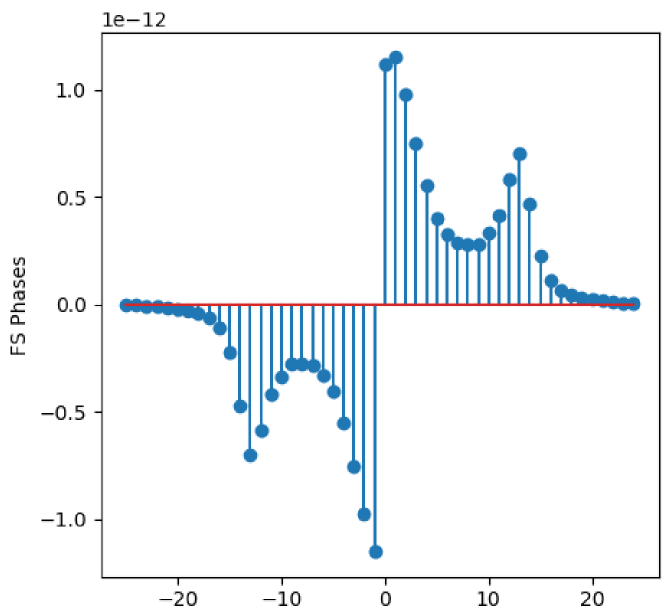


Figure 10: $h(t)$ fourier series phases

## 6 Part E

Included are $r(t)$, $m(t)$, the Fourier Transform and the part (b) Fourier Transform.

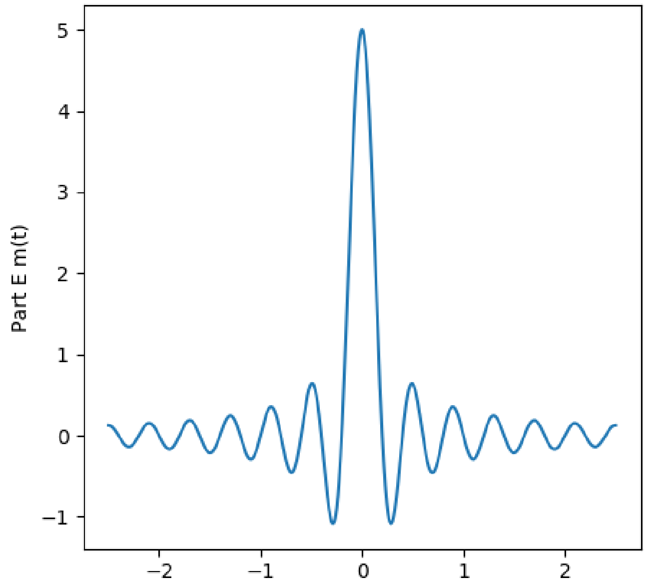


Figure 11: Part (E) $m(t)$

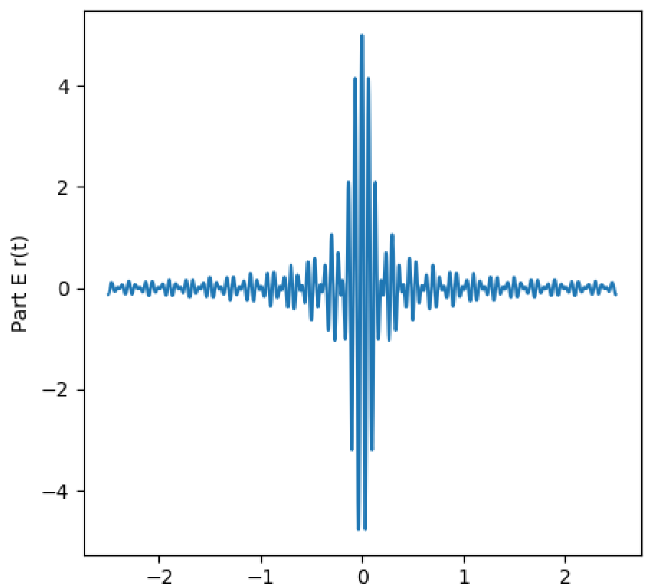


Figure 12: Part (E) $r(t)$

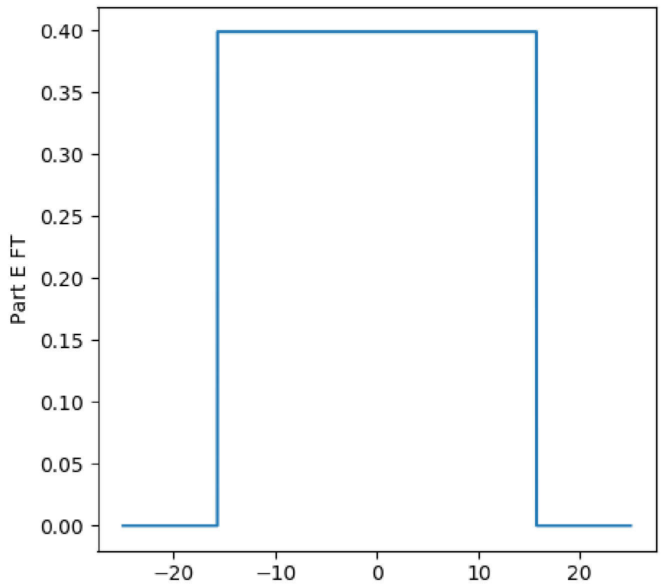


Figure 13: Part E Fourier Transform

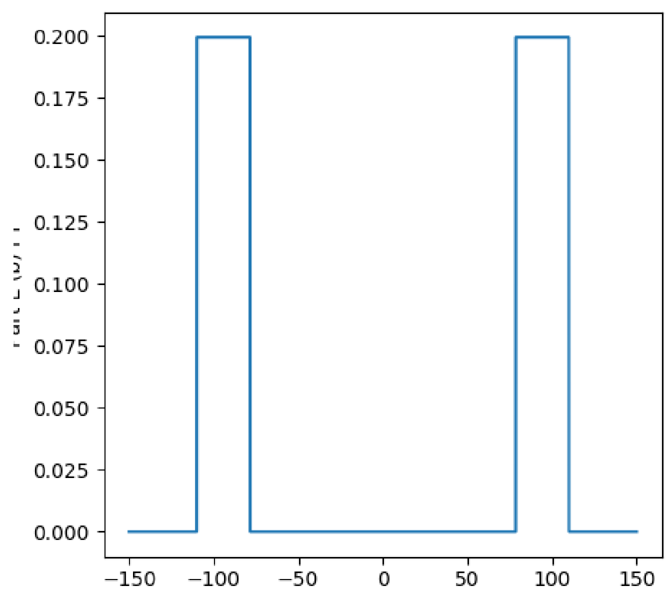


Figure 14: Part E (b) Fourier Transform

The relation in the time domain is $r(t) = m(t)cos(30\pi t)$. The corresponding relation in the frequency domain is $R(j\omega) = M(j\omega) * G(j\omega)$ where

$$G(j\omega) = FT\{cos(30\pi t)\} = \sqrt{\frac{\pi}{2}}\delta(-30\pi + \omega) + \sqrt{\frac{\pi}{2}}\delta(30\pi + \omega)$$

This is because multiplication in the time domain is equivalent to convolution in the frequency domain and vice versa.