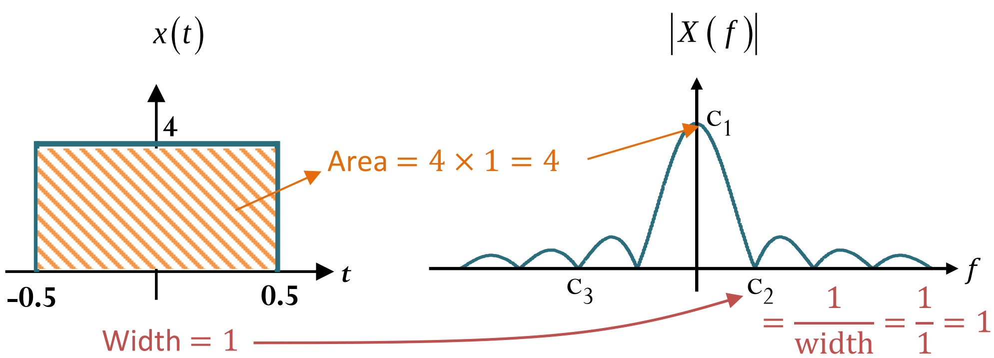
ECS 332: In-Class Exercise # 3 - Sol

Date: 2 8 / 0 8 / 2019			
Name	ID (last 3 digits)		

Instructions

1. Separate into groups of no more than three students each. **The group cannot be the same as any of your former groups.**
2. **[ENRE]** = Explanation is not required for this exercise.
3. **Do not panic.**

1. A signal and its magnitude spectrum are plotted below.

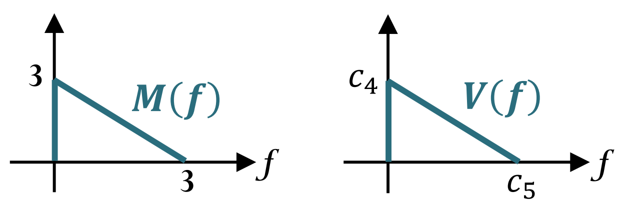


For this question, we apply observation 2.13 in the lecture notes:
(0) The Fourier transform of a rectangular function is a sinc function.
(i) The height of the sinc function's peak is the same as the area under the rectangular function.
(ii) The first zero crossing of the sinc function occurs at 1/(width of the rectangular function).
Note also that in the magnitude plot, the negative-valued parts of the sinc function are flipped up.

Find the values of the constants (corresponding to some zeroes and the peak value) shown in the plots.

$$c_1 = \underline{\ 4\ },\ c_2 = \underline{\ 1\ },\ c_3 = \underline{\ -2\ }.$$

2. Consider a signal $m(t)$ and another signal $v(t) = m(2t)$.
Their corresponding Fourier transforms are plotted below.



Find the values of the constants in the plot of $V(f)$:

$$c_4 = \underline{\ \tfrac{3}{2}\ },\ c_5 = \underline{\ 6\ }$$

For $v(t) = m(2t)$, by the scale-change theorem, we have

$$V(f) = \frac{1}{|2|} M\left(\frac{f}{2}\right) = \frac{1}{2} M\left(\frac{f}{2}\right).$$

In the previous exercise, we worked on time manipulation. Note that, back then, "time" was just a dummy variable. Here, it's the frequency f. We can get $M\left(\frac{f}{2}\right)$ from $M(f)$ by replacing f by $\frac{f}{2}$; graphically, this is a horizontal expansion by a factor of 2. This implies $c_5 = 2 \times 3 = 6$.

Finally, the $\frac{1}{2}$ in the front simply scales the height of graph by a factor of $\frac{1}{2}$. This implies $c_4 = \frac{1}{2} \times 3 = \frac{3}{2}$.