EES 351: In-Class Exercise # 4

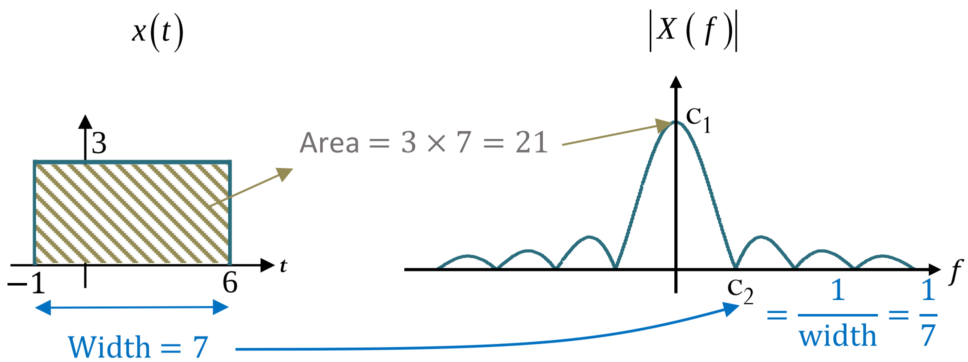
Date: 2 / 9 / 2020			
Name	ID (last 3 digits)		

Instructions

1. Work alone or in a group of no more than three students. For group work, **the group cannot be the same as any of your former groups in this class.**
2. [ENRE] = Explanation is not required for this exercise.
3. Only one submission is needed for each group.
4. You have two choices for submission:
   (a) Online submission via Google Classroom
   - PDF only.
   - Only for those who can directly work on the posted files using devices with pen input.
   - Paper size should be the same as the posted file.
   - No scanned work, photos, or screen capture.
   - Your file name should start with the 10-digit student ID of one member. (You may add the IDs of other members, exercise #, or other information as well.)

   (b) Hardcopy submission
5. **Do not panic.**

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



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

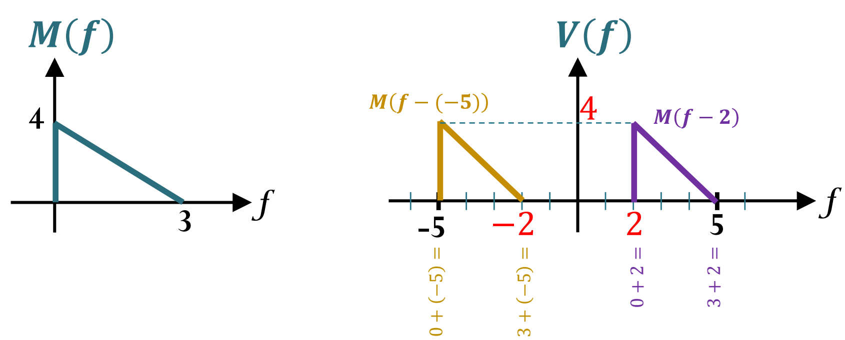
$c_1 =$ 21 $, c_2 =$ $\frac{1}{7}$.

This problem is similar to the one we have worked on in the previous exercise. However, the rectangular function is not centered at $t = 0$; it is time-shifted. From the time-shift property (2.31) of Fourier transform, we know that the magnitude spectrum plot won't be affected by this time-shifting. So, we can still use 2.13. In particular,
(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).

2. Consider a signal $m(t)$. Its Fourier transform $M(f)$ is plotted below.

   Let $v(t) = e^{-j10\pi t}m(t) + e^{j4\pi t}m(t)$. $= e^{j2\pi(-5)t}m(t) + e^{j2\pi(2)t}m(t)$

   Plot $V(f)$ in the corresponding space below.



Note that the plots of $M(f-(-5))$ and $M(f-2)$ do not have any (nonzero) overlapping part, so the plot of their sum is the same as what we already have here.

From the frequency-shift property of Fourier transform, we know that $e^{j2\pi f_0 t}m(t) \xrightarrow{\mathcal{F}} M(f - f_0)$.

In particular, $e^{j2\pi(-5)t}m(t) \xrightarrow{\mathcal{F}} M(f-(-5))$ and

$e^{j2\pi(2)t}m(t) \xrightarrow{\mathcal{F}} M(f-2)$.

Therefore, $e^{j2\pi(-5)t}m(t) + e^{j2\pi(2)t}m(t) \xrightarrow{\mathcal{F}} M(f-(-5)) + M(f-2)$.