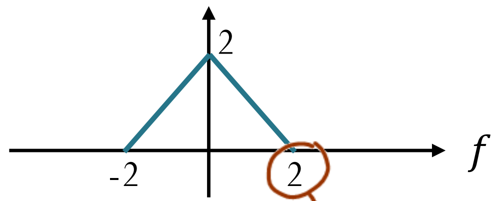
# ECS 332: Exercise **Solution**

## Instructions

1. Separate into groups of no more than three persons.
2. The group cannot be the same as your former group.
3. Only one submission is needed for each group.
4. ***Write down all the steps*** that you have done to obtain your answers. You may not get full credit even when your answer is correct without showing how you get your answer.
5. **Do not panic.**

| Name | ID |
|---|---|
| Prapun | 555 |
| | |
| | |

Consider a continuous-time signal $g(t)$ whose Fourier transform is plotted below.




(a) Find the Nyquist sampling rate for this signal.

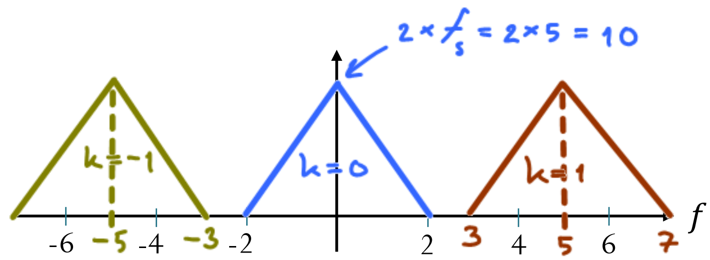
Nyquist sampling rate $= 2 \times f_{max} = 2 \times 2 = 4$ [Sa/s]

Note that $f_{max}$ is NOT the freq. at which the spectrum is maximum.

Mathematically, $f_{max} = \max\{f : G(f) \neq 0\}$.

(b) The ideal sampled signal $g_\delta(t)$ is defined by $g_\delta(t) = \sum_{n=-\infty}^{\infty} g[n]\,\delta(t - nT_s)$ where $T_s$ is the sampling interval.

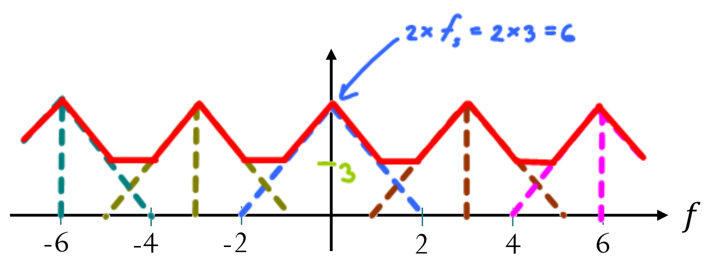
a. Plot the Fourier transform of $g_\delta(t)$ when $T_s$ = 0.2. $\Rightarrow f_s = \frac{1}{T_s} = \frac{1}{0.2} = \frac{10}{2} = 5$




$$G_\delta(f) = \sum_{k=-\infty}^{\infty} f_s\, G(f - kf_s)$$

Only $f_s G(f - kf_s)$ for $k = -1, 0, 1$ are shown here. The contributions from other $k$ values are outside of this region.

b. Plot the Fourier transform of $g_\delta(t)$ when $T_s$ = 1/3. $\Rightarrow f_s = \frac{1}{T_s} = 3$





Note: The sum of two straight lines is also a straight line.

$$\left( \begin{aligned} &(a_1 f + b_1) + (a_2 f + b_2) \\ &= (a_1 + a_2) f + (b_1 + b_2) \end{aligned} \right)$$

So, it is sufficiant to simply look at their sums at the two boundaries and connect them using straight line.


Using similar triangle,

$$\frac{1}{2} = \frac{h}{6} \Rightarrow h = \frac{1}{2} \times 6 = 3$$