Today, we will: Start a new topic – **Signal Conditioning (filters, amplifiers, etc.)**

- Do a review example problem – anti-aliasing filter application & FFT
- Review the pdf module: **Filters**, and do some example problems

Example: FFT with an anti-aliasing filter

Given: A signal contains:

- A 200 Hz periodic component at 5.0 V amplitude (the desired signal).
- A 700 Hz periodic component, also at 5.0 V amplitude (undesired noise).

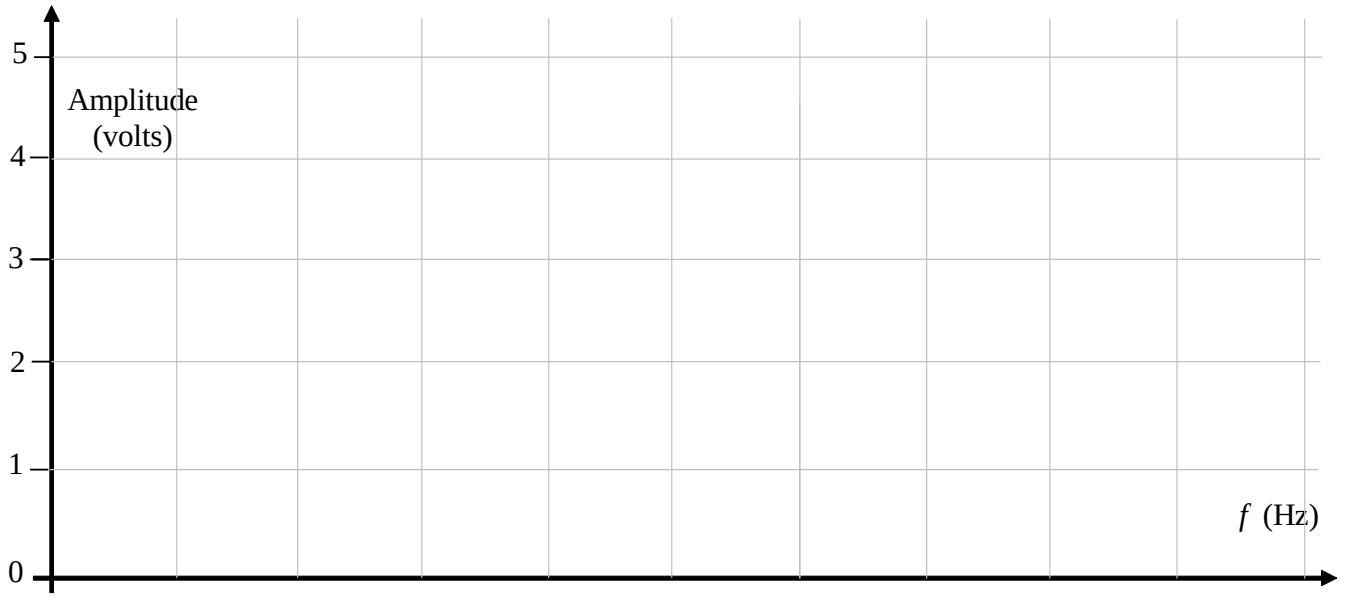
We low-pass filter the signal to attenuate the 700 Hz component. The filter reduces the amplitude of the 700 Hz component of the signal by a factor of five, but it does not significantly affect the 200 Hz component.

We sample the signal digitally at 1000 Hz, taking 512 data points.

(*a*) To do: Calculate the frequency resolution.

(*b*) To do: Sketch what the frequency spectrum will look like.

Solution:



Example: Filters

Given: A voltage signal contains useful data up to about 1000 Hz. There is also some unwanted noise at frequencies greater than 3000 Hz. We want to use a low-pass filter so that the noise is attenuated by at least 95%. We plan to use a cutoff frequency of 2000 Hz so that there is minimal attenuation of the 1000 Hz component of the signal.

To do: Calculate the required order of the low-pass filter.

Solution:

Example: Filters and digital data acquisition

Given: Vibrations around 90 Hz with an amplitude of about 5 V are measured with a DAQ. Data are sampled at f_s = 500 Hz (exceeding the Nyquist criterion). Unfortunately, there is also some electronic interference noise at 3600 Hz, with an amplitude of about 1 V.

To do: Sketch the frequency spectrum that you would expect to see for two cases:

- as is (no filter)
- with a 4th-order low-pass anti-aliasing filter set to a cutoff frequency of 200 Hz

Solution: