Please staple this cover sheet in front of your answers. (Behind Department of Physics coversheet.)

NAME: **ID#:**

ELEC441: Assignment 6

Due 4pm Wednesday 28th April 2021

https://amoqt.otago.ac.nz/people/asbradley/elec441

1. The zip file at `https://www.dropbox.com/s/z3zha01sfhuo01n/piano.zip?dl=0` contains the files

   - `piano_chord.wav` - a digitized recording of a three note chord being played on a piano.
   - `sound_in_matlab.m` - an example of how to manipulate sound in Matlab.

   Make a Matlab `.m` file that does the following things

   (a) Make a plot of the power spectrum for the chord, over the frequency range from -2000 to 2000 Hz. (You should be able to see that the vibrating strings have fundamental frequencies of around 440, 523 and 698 Hz). Comment on the symmetry or otherwise around the line $\nu = 0$.

   (b) Make a copy of the waveform and remove all the frequency components except those within 25 Hz of 523.25 Hz and each of its harmonics, up to the Nyquist frequency. Play the resulting sound and save it to `one_note.wav`. The result should only contain sound from the middle note of the chord. Why doesn't it have as sharp a start as the chord?

   (c) Make a copy of the original wave form and calculate the effect of passing it through a band pass filter with impulse response given by

   $$h(t) = 50u(t)\exp(-10t)\sin(2\pi 440t), \quad t \text{ in seconds}$$

   Plot the absolute value and argument for the transfer function of this filter around $\nu = +440$ Hz.

   Send the resulting sound to the speakers and save the waveform to `band_pass.wav`

   Attach a listing of your m-file and the two plots to your assignment, and make a zip file called `YourLastname_a6.zip` and include in it: Your m-file, `piano_chord.wav`, `one_note.wav` and `band_pass.wav`.

SCORE: