- Maintain Academic Honesty. You can discuss with others but the solution should be yours.
- For the written assignment, write it in hand and submit a scanned version (pdf) on moodle. Make sure that your scan is readable so that it can be corrected easily.
- **Simulation:** Submit solutions for simulation problems on Colab using python.

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1. [5 points] Simulation: Digital filter design: Design a discrete-time lowpass filter for the specifications given below:

   - Sampling frequency = 10 kHz;
   - Passband edge = 260 Hz; stopband edge = 340 Hz;
   - Passband ripple = 0.1 dB; min. stopband attenuation = 30 dB

   Use the following filter design methods and write your own code to achieve the given specifications.

   (a) Hamming windowing

   Optional: You can also try using Matlab's `fdatool` or equivalent python tool for filter design to obtain a Parks-MCClellan or Remez filter.

2. [5 points] Simulation: In this problem, you will listen to different frequency components of a music file to see what components of the music you are able to discern.

   - First, fetch Johann Bach's music piece 'Brandenburg Concerto No. 3 – 1. Allegro" from here: `https://en.wikipedia.org/wiki/File:Bach_-_Brandenburg_Concerto_No._3_-_1._Allegro.ogg`
   - Convert the first 20 seconds to a WAV file.
   - Use scipy.io.wavfile.* functions in Python to load the file.

   Now, do the following:

   (a) Develop four linear phase filters using `remez`, each of length 200. The first should be a low-pass filter with cut-off corresponding to 4 kHz. The second should be a band-pass filter with pass-band between 4 to 8 kHz. The third is a band-pass filter with pass-band from 8 to 12 kHz. The final filter is a band-pass filter with pass-band from 12 to 16 kHz.

   (b) Filter both the left and right channels with each of the above filters. Listen to the output. What do you observe in each case?