ACOUSTICS – ASSIGNMENT 1(Based on Timbre)

1. Use an excel sheet/python programming and generate numerically 3 sine waves ,ie a fundamental note and at least 2 overtones (see eg in slide 5). Vary the phases and amplitudes and generate a composite time domain signal. Generate plots of the 3 input waves and the generated composite temporal signal. The report should contain the input phase and frequencies of the signals added.

2. Generate a saw tooth wave, a square wave and triangular wave at a frequency equal to the last 4 digits of your roll number. (See hints given in slide no 8).

   Instructions: Do not use the function calls to sawtooth, square or triangular waves in Python. You need to form a mathematical equation for adding overtones at required amplitude and phase and then run the equation to generate the waveform. For this,

   Step 1 set the value of fundamental frequency *c*

   Step 2

   Use *n* as a variable for denoting the maximum number of overtones that you are superimposing and *A* as the variable representing the amplitude of the fundamental frequency *f*. Give initial values for A, n =1 and frequency = *f*. So your expression for the waves can be $y_n = A_n \sin(2\pi nft - \phi_n)$. For example, A_n can be A/n or A/n^2 as required.

   Form your own equations for combining odd/even or odd & even sine or cosine overtones and the fundamental wave with appropriate phases. Use the ppt slide no 8 and the link to the tool as a guideline to see and identify the required pattern for each type of wave that needs to be synthesized and hence formulate the equation. Your final equation will be a summation of all *n* waves with the amplitude, phase and frequency of each overtone wave should be expressed in terms of *n*.

   Step 3 Run and generate plots.

3. Find the function used to analyze Fourier transform of a time domain signal in MATLAB and Python.

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