Musical note generation using Pt-51

1. [20 points] In this project, you will be writing a program to generate musical notes and play out a small musical piece.

   - You will have to generate various musical notes corresponding to the set of frequencies shown in the Table 1. The musical notes can be generated as square or sinusoidal waveforms. These can be generated and output using the speaker with appropriate interfacing. Also have an option to vary the duration of the note played.
   - Write a program to take user input for playing one of seven note (through the switches) and play it out (using speaker) for a duration of 1 s followed by a pause of 1 s, and cycle this five times. Simultaneously the note name or frequency needs to be displayed on the LCD. The 1st switch position can be used to choose between playing single note or a musical piece. The remaining switches can be used to choose a specific note or musical piece.
   - Use the sequence of notes and durations shown in Table 2 to generate and play out a popular musical piece such as "Sare jahan se acha". You can also play other musical pieces, such as "Twinkle twinkle little star", etc. depending on the switch position. While playing the musical piece the LCD can display the name of the piece.
   - Use the graphite touch-pad interface to play out tones, so that you can simulate a electrical guitar. [Inputs from Arjun]

Musical notes

Table 1 lists the various notes used in an octave, in Indian classical music. Sa, Re, Ga, Ma, Pa, Dha, Ni, are Shuddha Swars. Out of these seven swars Re, Ga, Dha, and Ni become "Komal" when their frequency is lower than their Shuddha form.

For generating these notes, it is required to generate various frequencies using the ratios given in Table 1. Complete the table with appropriate frequencies and timer values, to be used during the lab session.

Octave refers to one set of 7 major notes Sa, Re, Ga, Ma, Pa, Dha, Ni. The next octave begins from Upper Sa. In lower octave, all the notes will have a frequency half the corresponding frequency in the next octave. i.e., here you have generated octave of 240Hz to 480Hz with all the intermediate frequencies as written in the table. For lower octave, halve the corresponding frequencies and they will vary from 120 Hz to 240Hz.

Table 2 provides the sequence of notes and their duration for the notes to be played for the song "Sare jahan se achchha".

Table 1: Base notes and frequencies in Indian classical music.

S. No.	Note	Ratio (x)	Frequency (240*x)	Timer Value (TH0 TL0)
1	Sa	1		
2	Komal Re	16/15		
3	Re	9/8		
4	Komal Ga	6/5		
5	Ga	5/4		
6	Ma	4/3		
7	Tivra Ma	64/45		
8	Pa	3/2		
9	Komal Dha	8/5		
10	Dha	5/3		
11	Komal Ni	16/9		
12	Ni	15/8		
13	Sa (Upper Octave)	2/1		

Table 2: Notes and durations for a “Sare jahan se achchha”

S. No.	Note	Duration (Seconds)
1	Komal Ga	0.66
2	Re	0.66
3	Sa	0.33
4	Re	0.66
5	Ni(in lower Octave)	0.33
6	Sa	1
7	Pause	0.33
8	Pa (in lower Octave)	0.33
9	Dha (in lower Octave)	0.33
10	Sa	0.66
11	Re	0.33
12	Ga	0.66
13	Ma	0.33
14	Ga	1