

Experiment No: 3 – Frequency analysis of signals using DFT

1. Table below gives the notation based on the standard concert pitch for different frequency tones. The track files *Guitar1.wav* to *Guitar5.wav* contain single notes of electric guitar instrument.
 - (a) Try to map each .wav file to the corresponding note by analysing their frequency spectrum (plot the magnitude in dB scale for better representation).
 - (b) Also given is a single note from a flute instrument *Flute1.wav*.
 - i. Find the corresponding note and,
 - ii. Plot the spectrum along with the frequency spectrum of the Guitar with the approximately same note.

Frequency in hertz (semitones above or below middle C)								
Octave → Note ↓	0	1	2	3	4	5	6	7
C	16.352 (-48)	32.703 (-36)	65.406 (-24)	130.81 (-12)	261.63 (±0)	523.25 (+12)	1046.5 (+24)	2093.0 (+36)
C#/D♭	17.324 (-47)	34.648 (-35)	69.296 (-23)	138.59 (-11)	277.18 (+1)	554.37 (+13)	1108.7 (+25)	2217.5 (+37)
D	18.354 (-46)	36.708 (-34)	73.416 (-22)	146.83 (-10)	293.66 (+2)	587.33 (+14)	1174.7 (+26)	2349.3 (+38)
E♭/D#	19.445 (-45)	38.891 (-33)	77.782 (-21)	155.56 (-9)	311.13 (+3)	622.25 (+15)	1244.5 (+27)	2489.0 (+39)
E	20.602 (-44)	41.203 (-32)	82.407 (-20)	164.81 (-8)	329.63 (+4)	659.26 (+16)	1318.5 (+28)	2637.0 (+40)
F	21.827 (-43)	43.654 (-31)	87.307 (-19)	174.61 (-7)	349.23 (+5)	698.46 (+17)	1396.9 (+29)	2793.8 (+41)
F#/G♭	23.125 (-42)	46.249 (-30)	92.499 (-18)	185.00 (-6)	369.99 (+6)	739.99 (+18)	1480.0 (+30)	2960.0 (+42)
G	24.500 (-41)	48.999 (-29)	97.999 (-17)	196.00 (-5)	392.00 (+7)	783.99 (+19)	1568.0 (+31)	3136.0 (+43)
A♭/G#	25.957 (-40)	51.913 (-28)	103.83 (-16)	207.65 (-4)	415.30 (+8)	830.61 (+20)	1661.2 (+32)	3322.4 (+44)
A	27.500 (-39)	55.000 (-27)	110.00 (-15)	220.00 (-3)	440.00 (+9)	880.00 (+21)	1760.0 (+33)	3520.0 (+45)
B♭/A#	29.135 (-38)	58.270 (-26)	116.54 (-14)	233.08 (-2)	466.16 (+10)	932.33 (+22)	1864.7 (+34)	3729.3 (+46)
B	30.868 (-37)	61.735 (-25)	123.47 (-13)	246.94 (-1)	493.88 (+11)	987.77 (+23)	1975.5 (+35)	3951.1 (+47)

2. An ECG signal record is given in the text file *ECG_Data1.txt*. The sampling rate for the signal is 720 samples/seconds.
 - (a) Plot the signal with respect to time.
 - (b) Plot the frequency spectrum of the signal.
 - (c) Can you find the heart rate of the person?
 - (d) Use FFT and IFFT to remove the DC value and the frequency content above 20 Hz (making the DFT values zero for those indices of “k”). Plot the filtered response. Compare it with the original signal. What do you observe?