

Indian Institute of Technology Bombay

Dept of Electrical Engineering

Handout 3
Home Work 1

EE 603 Digital Signal Processing and Applications
July 27, 2016

Question 1) Consider the set of samples given by

$$x[n] = \cos\left(\frac{\pi}{12}n\right), n \in \mathbb{Z}.$$

(a) If the samples $x[n]$ are played out using an audio-card operating at 48kHz, what is the audible frequency.

(b) If the audio-card is set at 32kHz, what will be the audible frequency.

Question 2) Find the cubic interpolation of samples x_t for $t \in \{0, 1, \dots, 4\}$, where $x_0 = 1, x_1 = 2, x_3 = 1, x_4 = 3, x_4 = -2$. All other values can be taken as zero.

Question 3) For the set of values given above, what is the Lagrange interpolation.

Question 4) Suppose speech is sampled at 8kHz and saved using 16 bit precision per sample. How much data-rate is required to send this uncoded speech waveform.

Question 5) GNURADIO: Build a logical circuit to compare two 3 bit numbers and find the maximum (Hint: better to use the data-type 'byte' and use packing and unpacking operations)

Question 6) GNURADIO: Generate the tune 'Happy Birthday to You' on the audio card.

Question 7) GNURADIO: Capture an audio signal with the sample rate set at f_a kHz, where $f_a \in \{8, 16, 24, 32\}$. Recall that 8kHz sample-rate can be obtained by doing 16kHz sampling and throwing off alternate samples. Capturing does not really need gnuradio, you can use a tool like 'audacity' or some windows program to get a *.wav file. Now, in gnuradio, set the audio sink to 48kHz. The assignment is to use a suitable cubic interpolator between the source and sink, so that the recordings can be played with good sound quality.