# CG1111 Engineering Principles and Practice I

## Tutorial for Week 11

Filters and Signal Processing Basics (Continued)

1. An audio song from a CD is passed through a low-pass filter with a cut-off frequency of 4000 Hz to obtain the signal *Y*(*t*). What is the minimum sampling rate that we can use to sample *Y*(*t*) without degrading its quality significantly?

2. A microphone is recording an audio song with a frequency range of the 5th octave. The song is corrupted by a 12 kHz noise. This recording needs to be sampled by an Arduino Uno for controlling the loudness of the speaker connected to the audio system.

    a. Design an analog low-pass filter to suppress the 12 kHz noise by at least 15 dB.

    b. What is the minimum sampling rate required for processing the audio song?

    c. If we need to design a digital low-pass filter to suppress the 12 kHz noise (instead of an analog low-pass filter), what is the minimum sampling rate required?

3. For the following passive first-order high-pass filter, show that its cutoff frequency is given by $f_H = \frac{1}{2\pi CR}$.