Digital Communications Lab

Lab #5

Experiment

1. Connect a sine wave generator, through an audio amplifier, to a speaker. Connect an oscilloscope to the speaker terminals. Produce a 1 kHz sine wave with the signal source, and adjust the speaker amplitude so it is audible, but not extremely loud. Note the voltage level on the oscilloscope. Do not exceed this voltage level in step 2.

2. Test the range of hearing for each person in your lab group. Have the person look away from the equipment, then repeatedly turn the sine wave generator on and off, randomly picking if it ends up on or off. Ask the test subject if they can hear the sine wave. They must be able to predict it reliably to be credited with hearing that frequency. Try this from frequencies from 1 Hz to 30 kHz.

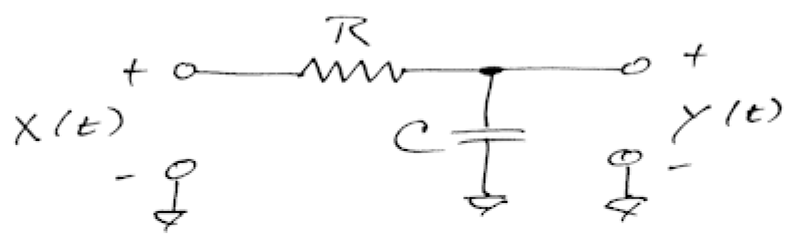
3. Toggle the signal between a sine wave and square wave. Start at a frequency that is around the upper range of what people in the group can hear. The two signals should sound the same, aside from a difference in volume. Slowly drop the frequency, while toggling back and forth between sine and square waves. What is the first frequency where you can detect the difference between the two waveforms? What does this say about the lowest harmonic used by the square wave? Look at the square wave on the spectrum analyzer, and see if you indeed see this harmonic, and if it is at the upper range of your ear's range.

4. Repeat the previous step switching between a sine wave and a triangle wave.

5. Repeat step 3, toggling between a sine wave and a half wave rectified sine wave. You will need to build a half wave rectifier using a diode and resistor.

6. Repeat step 3, toggling between a sine wave and a full wave rectified sine wave. You will need to build a full wave rectifier using four diodes and a resistor.

7. Build an R/C low pass filter, with a resistor of 1 kohm and a Capacitance of 0.1 uF. Use a 1 volt sine wave for the input, x(t), and look at the output, y(t), on an oscilloscope. Measure the amplitude of y(t) as you vary the frequency of x(t) from 1 Hz to 1 MHz. Plot this amplitude in a graph that has frequency (in Hz) on the horizontal axis and amplitude of y(t) (in volts) on the vertical axis.



8. Based on what you measured in the previous step, and what you know about your range of hearing, predict if this circuit will create noticeable distortion when you put an audio signal through the circuit. Connect the input to the circuit to an audio source, such as the speaker output of the PC. Play an audio signal such as speech or music. Listen to the signal both before it goes through the filter, and after it comes out, and determine if you were correct in your prediction.

9. Change the value of R and/or C in your circuit, until you no longer notice a difference between the input and output signals, when you listen to them on the speaker. Then go back and check the circuit by putting in a sine wave at different frequencies, and measure how much it changed over your range of hearing. How much variation in amplitude could you tolerate?

10. Put the values of R and C back to 1 kohm and 0.1 uF. To speed up the measurement of your circuit, connect the signal source so it generates a sine wave that sweeps from 1 Hz to 1 MHz. Feed this swept sine wave to the oscilloscope, and synchronize it so each new sweep starts at the left side of the screen. Does this allow you to make the same measurements as you did before?