1. Download the Pd instrument flute.pd (available from the course site) that uses 2 delay lines to model a wind instrument (as per diagram on p.9 of lecture notes on wind instruments (winds170.pdf)).

(a) Record 1 second of noise; Set both vdelay objects to .001 seconds; Click “-1” for an open-open tube and play sound (by clicking on play in the record object and making sure output is toggled on and is set to a gain of about 80 dB); Click “1” for an closed-open tube; What is the pitch difference (musical interval) between the two cases?

(b) If modeling an open-open tube sounding at 200 Hz, to what value (in seconds) should each delay line be set?

(c) If each delayline is set to 0.000625 seconds, what should be the sounding pitch (barring additional feedback delay) if it is configured as a closed-open pipe?

(d) How much longer is the wavelength produced by a closed-open cylindrical tube than one that is the same length but open-open?

2. Write the configuration of pressure-controlled valve, (+,-), (-, +), or (+, +), that best describes the reeds of the following instruments:

(a) saxophone and clarinet __________.

(b) trumpet and trombone __________.

(c) human voice __________.

3. What is the observable spectral difference between different vowel sounds? Similarly, what characteristic can be observed in the spectrum of a singer’s voice, trained to project more efficiently?

4. Why might a sound coming from the right-hand side of a listener have less intensity at the left ear than the right? How does the human auditory system 1) amplify sound pressure from outer to inner ear and 2) determine frequency content presented to, and interpreted by, the brain?

5. Though the perceived loudness of a sound is dependent on its intensity (or sound level), it is also dependent on frequency (among other factors). Using the Fletcher and Munson equal loudness curves from the notes, answer the following:

(a) How many phons is a 100-Hz tone sounding at 85 dB?

(b) At what level (in dB) would a 60 Hz tone have to be to sound as loud as a 1000-Hz tone at 50 dB?

(c) Between loud and soft sounds, which has more variation with frequency?

(d) Why might it be easier to have a conversation during a bass solo than a saxophone solo (sorry bass players!)?

(e) Why is there a marked dip in the curves a 3000-5000 Hz?

(f) Why is there another dip in the curves at around 12000 Hz?
6. Optional (study) questions:

   (a) What is the main advantage of binaural listening (i.e., listening with two ears)?
   (b) On what does the $T_{60}$ depend?
   (c) What is the precedence effect?
   (d) What is the advantage of having a room’s impulse response (IR)?
   (e) What aspects of the IR contribute to our sense of a room’s size?

CAPE EVALUATIONS: You have received an email requesting your important evaluation of this course. I would greatly appreciate your feedback as I am always trying to make improvements to future offerings of the course. To encourage response to the CAPEs (which are anonymous), 2 marks will be added to the final grade of every student in the class if the response rate is greater than 90% by the time this assignment is graded. Please complete your CAPEs!