UNIVERSITY OF WISCONSIN—MADISON
COMMUNICATION SCIENCES AND DISORDERS
Electroacoustics and Instrumentation Calibration (CSD 854/855), Fall 2017

LECTURE:	Mondays 4:15 – 5:55 pm; Goodnight Hall, Rm. 412
LAB (UW-Madison):	Wednesdays 3:00 – 5:00 pm; Goodnight Hall Rm. B32 or 403
INSTRUCTOR:	Sriram Boothalingam, PhD, MSc Audiology
OFFICE LOCATION:	Goodnight Hall, Rm. 482
OFFICE HOURS:	Wednesdays after lab (5-6 PM) only by appointment
E-MAIL:	boothalingam@wisc.edu (Please include "CSD 854/5" in the subject line of all emails)
Prerequisites:	CSD 303 or CSD Major or Consent of instructor

Expected learning outcomes:
Upon successful completion, students will be able to:

1. Describe the importance of calibration and knowledge of instrumentation in the profession of audiology.
2. Identify basic methods and instruments used to calibrate audiological equipment.
3. Appropriately record the results of an acoustic calibration and an electric calibration.
4. Perform basic troubleshooting on clinical audiological equipment.
5. Describe basic properties of electricity and of acoustics.
6. Identify factors that contribute to signals that may be out of calibration.
7. Identify the effect of poorly maintained equipment on the use of best practices in audiology.
8. Recognize the School of Education Standard 9 (Manages learning environment; e.g., hearing conservation, classroom modifications)

Recommended texts:

1. Rosen, Stuart and Howell, Peter. (2013). Signals and Systems for Speech and Hearing, 2nd ed. Brill Academic Pub, ISBN-13: 978-90-04-25243-1
2. Decker, T. Newell and Carrell, Thomas D. (2004). Instrumentation: An Introduction for Students in the Speech and Hearing Sciences, 3rd ed. Mahwah, NJ: Lawrence Erlbaum. ISBN-10: 0-8058-4681-6
3. Readings will include other relevant materials not covered in the text books and will be posted in respective Modules and/or Files on Canvas.

Course format: Lecture/discussion, laboratory exercises, group projects and presentations.

Lab exercises: Most weeks we will have a "live lab" where we will get to work hands-on with electrical and acoustic calibration instruments. These labs will either be at Goodnight Hall Rm. B-32 or Rm. 403 depending on the type of content.

Methods of communication:
Course website is on https://canvas.wisc.edu. All lectures and study guides will be available in the "***Modules***" tab. Lecture slides will be made available at least 1-2 hours before class. Updates to course content will be made throughout the week; it is your

responsibility to check for updates. All lab assignments have to be submitted via the respective "***Assignments***" on Canvas. All exams will be taken in class or during lab hours.

Grading:
Grades will be determined by:
Class participation – 5%
Group project – I – 15%
Group project – II – 15%
Mid-term exam – 30%
Final exam – 35%

Scale:

Percentage	100-92	91.9-88	87.9-82	81.9-78	77.9-72	71.9-68	67.9-60	<60
UW-Madison letter grade	A	AB	B	BC	C	CD	D	F

Attendance:
Lecture content will be complementary to labs. Students are therefore strongly encouraged to attend all lectures and labs.

Emergency planning and management statement:
If an emergency situation occurs or an illness is spread throughout the campus to the extent that it interferes with basic functions, the university, state, and local officials may implement "social distance teaching." This means that face-to-face instruction will be restricted. Instruction of essential courses will continue, but it will be provided via distance methods. In the event that this course is no longer able to meet face-to-face, students will be contacted with instructions via email. You should also monitor the UW-Madison homepage (wisc.edu) for emergency information. Distance methods for this course include provision of lecture materials and study guides on Canvas and online examinations.
If the emergent situation is a pandemic illness such as the flu, and classes are in session as usual, but if you become sick and cannot attend class, you should email to let me know of your absence. Please visit http:/flu.wisc.edu for information about the flu including symptoms and what to do if you suspect you have the flu.

Accessibility:
Students with disabilities will be accommodated as recommended by the McBurney Center (http://www.mcburney.wisc.edu/). If you have a disability for which you feel you may need further assistance during an emergency situation, during a pandemic event, or if you become sick, please contact the McBurney Center for planning purposes.

Religious conflicts:
In accordance with University of Wisconsin policy, any potential conflict between class requirements and religious observance must be made known to an instructor within the first week of class. The student must notify the instructor of the specific day(s) or date(s) of specific religious observances for which the student seeks relief from academic requirements.

Academic honesty:
All students are expected to perform independently on examinations. Cheating, if discovered, will result in an automatic failure in examination. It is the responsibility of

students to read and understand the UW-Madison Misconduct Guidelines, posted at https://conduct.students.wisc.edu/

Group projects:

1. **Comparison of phone app-based sound level meters with a standard (class 0/1) sound level meter**
    - 3 groups in Madison and 1 group in Stevens Point
    - Each group will evaluate at least two different phones, and compile all results into one project. So, plan accordingly with other groups so your data are compatible and easily portable between groups.
    - Present your final results as a class presentation (on 12/4/2017). At least one person from each group should present part of the presentation.
    - Presentation should have the following components:
        i. Introduction and motivation for the research project
        ii. Methods used
        iii. Results
        iv. Discussion and conclusion
    - What am I looking for in the presentation?
        i. Display of knowledge in the area of presentation
        ii. Quality of content
        iii. Quality of methods (because multiple group data need to be compiled together, think about how you could homogenize your stimuli and set-up used in the project).
        Different stimuli can have different effects on how phones process them, so think about what might be an appropriate stimulus for your testing.
        iv. Quality of results (extra points for the use of appropriate statistics)

2. **Know your instruments!**
    - Groups will be randomly assigned an audiological instrument (same groups as project-1)
    - Each group will research on the instrument type and gather specific details (explained below) about a physical instrument that they have access to. For example, if your group is assigned with an audiometer, your group will research about audiometers in general, and also gather specific details about an audiometer that you can access.
    - Specific details include (but not limited to): input/output ports, functions that the instrument can perform, comparison to standard, and calibration record.
    - Present your findings as a class presentation (on 12/4/2017). At least one person from each group should present part of the presentation.
    - Presentation should have the following components:
        i. Introduction to the instrument
        ii. What are its features and what does it do?
        iii. Description of the specific instrument that you accessed
        iv. Calibration record
    - What am I looking for in the presentation?
        i. Display of knowledge in the area of presentation
        ii. Quality and clarity of content and depth of background research

Course content and schedule:

Date	Lecture Topics	References/readings
11-Sep - AM	**Introduction and basics**	
During CSD 850	Course and lab Introduction, KASA, and key terms	
	Essential basics – scientific notation, exponents and logarithms	Rosen and Howell (ch 1,3 appendix)
	Physical concepts	Durant and Lovrinic (Ch 1.1-1.6)
11-Sep - PM	**Simple Harmonic Motion**	
During CSD 854	Simple Harmonic Motion and sinusoids	Durant and Lovrinic (Ch 1.7-1.9)
	Amplitude, frequency, period, wavelength, and phase	Rosen and Howell (ch 3)
	Reactance and resonance	
13-Sep - AM	**Sound and its quantification**	
During CSD 850	Sound	Rosen and Howell (ch 2)
	Waves and their superposition	Durant and Lovrinic (Ch 1.10)
	Sound power, intensity and pressure	Rosen and Howell (ch 3)
	dB scales	
18-Sep - AM	**Systems**	Rosen and Howell
During CSD 850	Linear systems	Ch 4
	Fourier Transform/ STFT, spectrogram	Ch 7, 11
25-Sep	**Filters and sound-level meters**	Rosen and Howell
Back to regular	Impulse/frequency response of systems	Ch 8, 9, 10
class timing	Filters	Ch 6, 8
	Sound level meters	
	Time/frequency weighting scales	
2-Oct	Break (no class)/project work/buffer for overflow content	
9-Oct	**Into the Matrix: all things digital**	
	Digital systems	Rosen and Howell (Ch 14)
	A/D & D/A issues	Decker (ch 4)
	Distortion/clipping	
	Noise	

16-Oct	**Electricity I**	
	Current/voltage/resistance	Decker (ch 1)
	Electrical circuits and components	
	Multimeters, implications for electrophysiology (EEG)	http://hyperphysics.phy-astr.gsu.edu/hbase/emcon.html
23-Oct	**Electricity II**	
	Electromagnetism, implications for magnetoencephalography (MEG)	Decker (ch 1)
	open circuits / short circuits	
	Inductance/capacitance	
30-Oct	**Mid-term (30%)**	
6-Nov	**Impedance**	
	Impedance / admittance	Decker (ch 7), Durant and Lovrinic (Ch 1.11)
	Forward pressure calibration, implications for otoacoustic emissions (OAEs)	Goodman lecture slides
13-Nov	**Visualizing electricity, and how not to get electrocuted!**	
	Oscilloscopes	
	grounding/safety/shielding	Decker (ch 1, 2, 10)
	interconnections & impedance matching (cabling)	
20-Nov	**Transducers**	
	Microphones	Decker (ch 3,6)
	Headphones	
	Loudspeakers	
	Amplifier and attenuators	
27-Nov	**Standards**	
	standards for calibration	http://www.asha.org/policy/RP1991-00025.htm
	Couplers	Decker (ch 5,8)
	octave band analyzers	
	other audiological instruments	http://www.asha.org/policy/RP1987-00024.htm
	calibration & troubleshooting	http://www.asha.org/policy/RP1988-00027.htm

4-Dec	**Revision**/buffer for overflow content	
11-Dec	**Group project presentations**/buffer for overflow content	
18-Dec	**Final exam – 35%** (non-cumulative)	

Lab schedule:
(Five assessable labs are in bold; best four is worth 25% each for CSD 855)

Date	Topic	Room
13-Sep	Introduction and exercises - frequency / logs / dB	403
20-Sep	**Signal characterization and analysis using Praat**	403
27-Sep	Sound level meters	B32
4-Oct	Permissible ambient noise levels	B32
11-Oct	**Digital Signal Processing (DSP)**	403
18-Oct	Snap circuits - I	B32
25-Oct	Snap circuits – II and exercises	B32
1-Nov	No lab/project work	B32
8-Nov	**Multimeters**	B32
15-Nov	**Oscilloscopes**	B32
22-Nov	Overview of calibration equipment	B32
29-Nov	**Calibration of tone audiometer**	B32
6-Dec	Calibration of short duration signals – implications for AEPs and OAEs	B32

ASHA standards addressed by this course (Knowledge and Skills Acquisition -- KASA):

Knowledge assessed through written or oral exam Upon successful completion of this course, the student will:	**ASHA Reference**	**Assessed through**
Instrumentation and bioelectrical hazards	A13	Assignments and Exams
Physical characteristics and measurement of electric and other non-acoustic stimuli	A14	Assignments and Exams
Universal precautions and infections/contagious diseases	A21	Assignments and Exams
Principles, methods, and applications of acoustics (e.g., basic parameters of sound, principles of acoustics as related to speech sounds, sound/noise measurement and analysis, and calibration of audiometric equipment), as applicable to: Occupational and industrial environments Community noise Classroom and other educational environments Workplace environments	A23	Assignments and Exams

The use of instrumentation according to manufacturer's specifications and recommendations	A24	Assignments and Exams
Determining whether instrumentation is in calibration according to accepted standards	A25	Assignments and Exams