WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON

COMMUNICATION SCIENCES AND DISORDERS

Electroacoustics and Instrumentation Calibration

CSD 854/5 | Fall 2018 | 2 (Theory) + 1 (Lab) Credits
https://canvas.wisc.edu/courses/106777

Meeting Time and Location

	Day	Time	Location
Theory	Mondays	4:15 – 5:55 PM	GNH 412
Lab	Wednesdays	3:00 – 5:00 PM	GNH B5 and 403

Instructional Mode

Lectures, demonstrations, handouts, videos, and worksheets will supplement assigned readings in the text (see course schedule).

How does this course meet the credit hour policy standard?

This class meets for one 1 hour 40 min class period and one 2-hour lab period each week over the Fall semester and carries the expectation that students will work on course learning activities (reading, writing, problem sets, studying, watching posted video, etc) for about 3 hours out of classroom for every class period. The syllabus includes more information about meeting times and expectations for student work.

INSTRUCTORS AND TEACHING ASSISTANTS

Instructor Title and Name

Sriram Boothalingam, PhD, MSc Audiology

Instructor and TA (Stevens Point)

Rachel Craig, Au.D.
Amanda Cegelske

Instructor Availability

Madison: Mondays, 3-4 PM by appointment; Goodnight Hall, Rm. 482
Stevens Point: 9-12 PM on Wednesdays, or by appointment. Office: 046B (715-346-4018)

Instructor Email/Preferred Contact

Madison: boothalingam@wisc.edu
Stevens Point: rachel.craig@uwsp.edu or TA: amanda.k.cegelske@uwsp.edu
Please include "CSD854" in the subject line of all emails

OFFICIAL COURSE DESCRIPTION

Course Description

This course involves the systematic review of physical concepts of acoustics, electricity, and electronics underpinning the practice of audiology, as well as formally adopted standards by which clinical environments, instruments and procedures are calibrated.

Requisites

None

LEARNING OUTCOMES

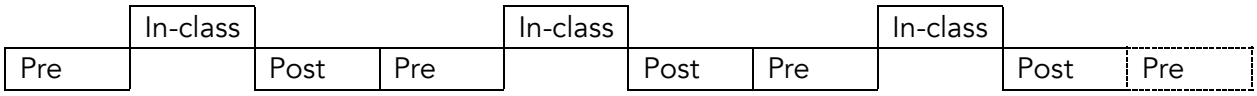
Overall Course Learning Outcomes

Upon successful completion of this course, students will be able to:

1. Describe sound, its characteristics, laws that govern its propagation, and its measurement and analysis
2. Describe the fundamentals of tools and clinical methods used in hearing science to study the auditory system
3. Describe the importance of calibration, knowledge of instrumentation, and electrical safety in the profession of audiology
4. Analyze and calibrate audiological equipment using calibration tools (e.g., sound level meter, couplers, etc)
5. Evaluate clinical equipment, perform basic troubleshooting, and determine if instrumentation works according to manufacturer specifications and standards

Course Structure

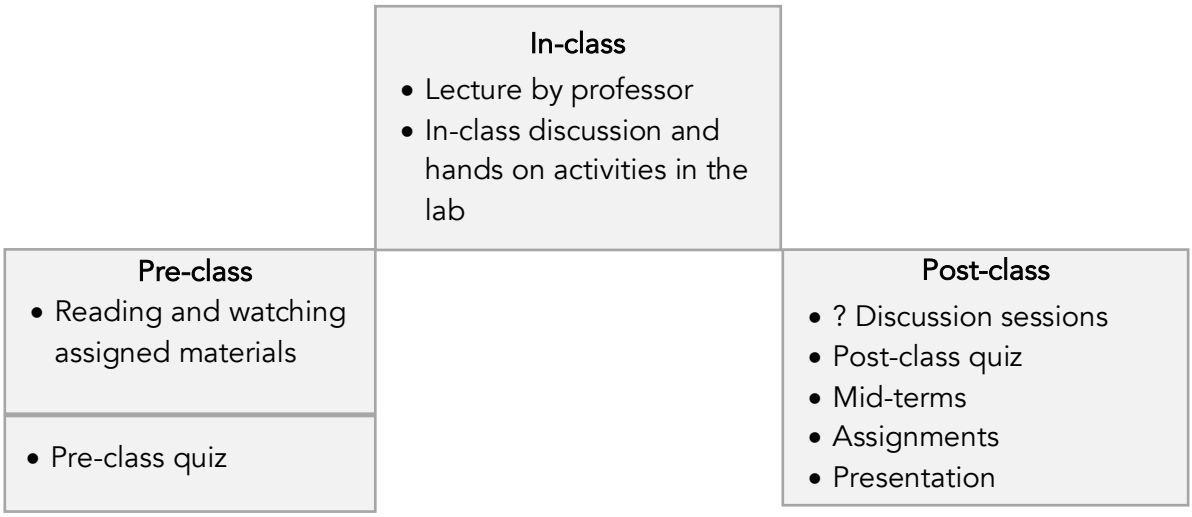
The course is presented as a quasi-blended course. Meaning, classroom lectures are minimized when possible in lieu of classroom discussions and hands-on labs. Minimization of classroom lectures will be made possible by increasing the chances of self-directed learning. This course structure is called the 'Castletop activity model' and is schematized below for better visualization.



Pre-class: **'Absorb'**	Course content will be presented as 'pre-class' reading, listening, and watching materials that you will have to complete before the scheduled class. This will allow you to ***absorb*** the material prior to class and be ready for classroom discussion of the same material rather than just listen to me for two hours. A pre-class quiz need to be completed prior to class. Therefore, the success of this method of teaching depends on your motivation to learn the material and being prepared to engage and discuss in-class.
In-class: **'Do'**	In the class, there will be further absorption, discussion, combined with hands-on ***do*** activities in the lab (CSD 855). Classroom activities will allow you think deeply about what you absorbed pre-class. This will be achieved by you talking individually or as small groups on the topic. Some talking points may include: what was easy? what was difficult? what is considered important? how does this apply to audiology? etc

Post-class: **'Connect'**	Because the course is constructed into a few serial ***units*** (see below), where learning every successive unit requires mastery of the previous unit, (almost) every class will have a 'post-class' quiz. This quiz is taken outside of the classroom at your leisure. Quiz will open on Wednesday night and is due before the midday Saturday of each week – this allows for you to focus on the pre-class reading, listening, and watching for next week's content from Saturday to Monday. Apart from the post-class quiz, exams, assignments, labs and presentations will allow you to think critically about these topics, help solidify the knowledge, and connect theoretical and practical aspects learned in-class to audiology and the real-world. Weekly (or once in two-week) discussion sessions could be conducted based on student availability.

The actual course structure schematic is below:



The course content is divided into five units (see weekly class schedule for details on specific topic covered). Every unit is designed to introduce you to the basics of the respective topic and help you understand as well as evaluate the link between these fundamentals and clinical audiology, as well as real-life. Lab practicum (CSD 855) is coordinated such that theory from CSD 854 can be put into practice in the lab (see weekly lab schedule for details on specific topic covered).

Unit 1: Acoustics

♫ **Important note**: this unit is common for CSD 854 and CSD 850 but will only be included in the exams and quizzes of CSD 854.

This unit contains the most fundamental of topics to your understanding of everything in audiology as it involves understanding and analyzing sound itself, the laws that govern sound propagation, and the means by which sound and sound systems are measured.
As understanding and analyzing sound involves a basic knowledge in physical concepts such as mass, elasticity, simple harmonic motion, and their attributes, we will devote a good chunk of time revisiting these topics.

Unit Outcomes

- Describe sound, its characteristics, and laws that govern its propagation
- Demonstrate knowledge in the measurement of sound and apply it in using audiological and

calibration equipment
- *In the lab*, you will apply your theoretical knowledge of simple harmonic motion and sound to get a deeper understanding of sound and its measurement.

Unit 2: Signals and systems

This unit will introduce you to linear and non-linear, and analog and digital systems on the systems end. We will also learn how systems convert analog signals to digital signals and vice versa. On the signals end, we will learn about different kinds of audio signals used in audiology and how signals are represented in the time and frequency domains.

Unit Outcomes

- Describe basic properties of general systems
- Apply your knowledge of sound and its measurement (unit# 1) to better understand the time (impulse) and frequency response of a system and ways in which we can go back and forth between the time and frequency domains
- Describe filters and apply this knowledge in measuring sound using a sound level meter
- Analyze the implications of signals and systems in audiology. For example, what kind of a system is the auditory system? what kind of a system does a hearing aid employ?
- *In the lab*, you will apply the knowledge of signals to synthesize, record, analyze, and evaluate various audio signals

Unit 3: Electricity

As an audiologist, you will deal with electrical instruments on a daily basis. This unit will introduce you to the fundamentals of electricity and electromagnetism. Understanding how electrical instruments function at a basic level will help you realize the power of electricity and how to safely and effectively handle it for use in audiology and beyond.

Electricity is also the language of neurons in our body and the brain. Electricity carries information about sound to the brain. We can measure this electric potential to determine if a patient is able to hear sounds without the patient telling us if they hear or not – auditory evoked potentials.

Unit Outcomes

- Describe electricity, electromagnetism, and various electrical components
- Describe the importance of electrical safety in audiology and beyond
- Analyze the implications of electricity and electromagnetism for audiology and hearing science. For example, how does the coal/hydro/nuclear/solar/wind power plant generated electricity thousands of miles away allow you test your patient's hearing? and how can we measure brain potentials safely?
- *In the lab*, you will apply the knowledge of electricity and electrical components by building fun circuits and using instruments that measure electricity in different forms.

Unit 4: Impedance

This unit will introduce you to the concept of impedance and will allow you to evaluate the implications of impedance for audiology and hearing science.

Impedance is the opposition to flow of energy. It has implications in mechanics, electricity, and acoustics. You will apply your knowledge in acoustics and electricity to understand impedance.

Unit Outcomes

- Describe impedance in its mechanical, electrical, and acoustical form
- Describe the role of impedance in the frequency response of the external and middle ear and its implications for hearing and hearing disorders
- Apply the knowledge of impedance in measuring sound conduction through external and middle ear (admittance)

Unit 5: Transducers and standards

The final unit will introduce you to various transducers in use in audiology and current standards for calibration of audiological equipment.

Unit Outcomes

- Describe the various audiological transducers and their uses in audiology
- *In the lab*, you will apply your knowledge of electricity and acoustics to build a useful tool (e.g., loud speaker). In addition, the last three labs will focus on calibration equipment and calibration for long and short duration signals.
- Identify factors that contribute to signals that may be out of calibration and troubleshoot audiological equipment
- Appropriately record the results of an acoustic and an electric calibration
- Identify and be able to use instruments to calibrate audiological equipment

Lab exercises: we will have a "live lab" every week where we will get to work hands-on with electrical and acoustic calibration instruments.

- Madison labs will either be at Goodnight Hall Rm. B5 or Rm. 403 depending on the type of content. See lab schedule (below) for more details.
- Stevens Point labs will be held in hearing aid lab 1 unless otherwise told to meet elsewhere.

GRADING, EXAMS, QUIZZES, PAPERS & OTHER MAJOR GRADED WORK

Grades will be determined from a maximum of 100 points, i.e., 100%.

Points breakdown:

In-class

- Class participation
  7.5 points

Pre-class

- Pre-class quiz
  10 * 1 (point) = 10 points

Post-class

- Post-class quiz
  8 * 2.5 (points) = 20 points
- Exams
  3 * 18 (points) = 54 points
- Assignments
  3 * 2 (points) = 6 points
- Group presentation
  1 * 2.5 (points) = 2.5 points

♫ Important notes on points:

- There is a total of 11 pre-class quizzes. Your best 10 will count towards the final grade
- There is a total of 10 post-class quizzes. Your best 8 will count towards the final grade
- Evaluation of class participation is subjective and observation based. The best way to score points in participation is to come prepared for the class on the day's content and engage in genuine discussion.

- **Group presentation: Know your instruments!**
  - Groups will be randomly assigned an audiological instrument. 3 groups in Madison, two groups in Stevens Point.
  - 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 standards, and calibration record.
  - Present your findings as a class presentation during the lab hour (on 12/5/2018). Everyone from the group should take turns presenting their content.
  - Your group will get a score for the overall presentation and (possibly) a peer review method will be used to scale group points to individual points.
  - 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 had access to
    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

Grade scale:

%	100-92	91.9-90	89.9-88	87.9-82	81.9-80	79.9-78	77.9-72	71.9-70	69.9-68	67.9-60	<60
UW-M	A	AB	AB	B	BC	BC	C	CD	CD	D	F
UW-SP	A	A-	B+	B	B-	C+	C	C-	D+	D	F

DISCUSSION SESSIONS

Optional discussion session on a weekly or biweekly (once in two weeks) basis can be arranged based on student availability. These sessions can be utilized as review sessions.

REQUIRED TEXTBOOK, SOFTWARE & OTHER COURSE MATERIALS

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. *Recommended*: 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 textbooks and will be posted in respective Modules and/or Files on Canvas.

OTHER COURSE INFORMATION

Important things to keep in mind:

- Let's build a community of learning and listening, where all students' voices are heard.
- Please feel free to ask any questions at any time. Every question and clarification attempt will get you closer to understanding the material better. So, there are no unwise questions, and nobody will judge you.
- Come to class prepared – this is important to success of both yourself and the learning model of this course.
- Leave social media out of the classroom and engage with what the class has to offer.
- Please see the course as a gateway to understanding your world better, and not to just get good grades.
- It is imperative that you understand the material and be able to apply the knowledge in real world, not just simply remember facts. This is the ultimate goal of any college education.
- I am delighted to be teaching this course. I hope you will enjoy the course and appreciate all the audiological equipment and the need for calibration better.

Policies that ensure courtesy to other students:

- Students are here to learn. Please be respectful of this. Avoid side conversations during class. It's not only disruptive to other students, but to the instructor as well.
- If you own a mobile phone or other device, put it away during class.
- Do NOT use text messaging, IM, email, social networking, etc during class. If you must do so, please leave the room first.
- Laptop computers, mobile phones and other electronic devices may only be active during class with the professor's permission.

Methods of communication:

Course website is on https://canvas.wisc.edu/courses/106777. All lectures and study guides will be available in the "Modules" tab. Lecture slides will be made available in PDF format before the class. Videos of Updates to course content will be made throughout the week; it is your responsibility to check for updates. All assignments have to be submitted via the respective "Assignments" tab on Canvas. All exams will be taken in class.

RULES, RIGHTS & RESPONSIBILITIES

- Students are responsible for all material covered in class and for all reading assignments. Students are highly encouraged to ask questions and participate in class discussion.
- It's up to students to decide if they want to purchase a calculator for this course. Exams will not require calculators.

ACADEMIC INTEGRITY

By enrolling in this course, each student assumes the responsibilities of an active participant in UW-Madison's community of scholars in which everyone's academic work and behavior are held to the highest academic integrity standards. Academic misconduct compromises the integrity of the university. Cheating, fabrication, plagiarism, unauthorized collaboration, and helping others commit these acts are examples of academic misconduct, which can result in disciplinary action. This includes but is not limited to failure on the assignment/course, disciplinary probation, or suspension. Substantial or repeated cases of misconduct will be forwarded to the Office of Student Conduct & Community Standards for additional review. For more information, refer to studentconduct.wiscweb.wisc.edu/academic-integrity/.

ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES

McBurney Disability Resource Center syllabus statement: "The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Students are expected to inform faculty [me] of their need for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. Faculty [I], will work either directly with the student [you] or in coordination with the McBurney Center to identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA."
http://mcburney.wisc.edu/facstaffother/faculty/syllabus.php

DIVERSITY & INCLUSION

Institutional statement on diversity: "Diversity is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals.

The University of Wisconsin-Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background – people who as students, faculty, and staff serve Wisconsin and the world." https://diversity.wisc.edu/

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.

COURSE CONTENT & SCHEDULE

(next page)

#	Day	Date	Unit	Topic	Readings	Post- class quiz due	Assign ment due
1	Wed - PM	5-Sep		Course and lab introduction	none		
2	Mon - AM	10-Sep	Acoustics	Physical concepts	Durant & Lovrinic (Ch 1.1-1.6)		
3	Mon - PM	10-Sep		Simple Harmonic Motion	Durant & Lovrinic (Ch 1.7-1.9) and Rosen &Howell (Ch 3)	15-Sep	
4	Wed - AM	12-Sep		Sound & its Quantification	Rosen & Howell (Ch 2 and 3)	15-Sep	
5*	Mon - PM	17-Sep	Signals & Systems	Signals & Systems	Rosen & Howell (Ch 4, 7 and 11)	22-Sep	
6	Mon	24-Sep		Revision			
7	Mon	1-Oct		Exam-I (topics from 10-Sep to 17-Sep)			
8	Mon	8-Oct	Signals & Systems	Filters	Rosen & Howell (Ch 6, 8, 9 and 10)	13-Oct	Assign ment-1
9	Mon	15-Oct		Digital Signal Processing	Rosen & Howell (Ch 14) and Decker & Carrell (Ch 4)	20-Oct	
10	Mon	22-Oct	Electricity	Electricity Basics	Decker & Carrell (Ch 1)	27-Oct	
11	Mon	29-Oct		Electromagnetism & Electrical Safety	Decker & Carrell (Ch 1, 2, 7, 10)	3-Nov	
12	Mon	5-Nov		Revision			
13	Mon	12-Nov		Exam-II (topics from 8-Oct to 29-Oct)			
14	Mon	19-Nov	Impedance	Impedance	Decker & Carrell (Ch2, pg 18-24) and Durant & Lovrinic (Ch 1.11)	24-Nov	Assign ment-2
15	Mon	26-Nov	Transducers & Standards	Transducers	Decker & Carrell (Ch 3, 6)	1-Dec	
16	Mon	3-Dec		Standards	Decker & Carrell (Ch 5, 8), http://www.asha.org/policy/RP1991-00025.htm http://www.asha.org/policy/RP1987-00024.htm http://www.asha.org/policy/RP1988-00027.htm	8-Dec	
17	Mon	10-Dec		Revision			
	Fri	14-Dec					Assign ment-3
18	Mon	17-Dec		Exam-III (topics from 19-Nov to 3-Dec)			

* Back to regular CSD 854 class schedule

CSD 855 LAB SCHEDULE

Five assessable labs are in bold; best four is worth 25% each for CSD 855

Date	Topic	Room
12-Sep	Introduction and exercises - frequency / logs / dB	403
19-Sep	**Signal characterization and analysis using Praat**	403
26-Sep	Sound level meters	B5
3-Oct	Permissible ambient noise levels	B5
10-Oct	**Digital Signal Processing (DSP)**	403
17-Oct	Snap circuits – fun with electricity	B5
24-Oct	Make your own loudspeaker	B5
31-Oct	**Multimeters**	B5
7-Nov	**Oscilloscopes**	B5
14-Nov	**Calibration of tone audiometer**	B5
21-Nov	TBD	B5
28-Nov	Calibration of short duration signals – implications for AEPs and OAEs	B5
5-Dec	Group presentations	B62

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

Knowledge assessed through written or oral exam	ASHA Reference	Assessed through
Instrumentation and bioelectrical hazards	A13	Quizzes, assignments, and exams
Physical characteristics and measurement of electric and other non-acoustic stimuli	A14	Quizzes, assignments, and exams
Universal precautions and infections/contagious diseases	A21	Quizzes, 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	Quizzes, assignments, and exams

The use of instrumentation according to manufacturer's specifications and recommendations	A24	Quizzes, assignments, and exams
Determining whether instrumentation is in calibration according to accepted standards	A25	Quizzes, assignments, and exams