SLHS 588A
Physiological Evaluation of the Auditory System: FALL 2015

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Class Meeting: SpH Sci. Room 409, MW 2:00 to 3:15 pm; Lab: Room 209, TBD.

Office hours: By appointment

Course Overview: Students will participate in lecture, discussion, and practica regarding the use of otoacoustic emissions and auditory evoked potentials recorded from the cochlea, auditory nerve and brainstem to assess the auditory system in infants, children and adults. Students will learn the theory and technique of auditory brainstem responses (ABR), auditory steady-state evoked responses (ASSR) and electrocochleography (ECoG), as evoked by acoustic and electric stimuli. Students will also learn the theory and technique of evoked otoacoustic emissions in the evaluation of the cochlea and efferent (olivo-cochlear bundle) auditory system. There will be an emphasis on the neurophysiologic bases of auditory evoked potentials and otoacoustic emissions and the way they are applied in the clinic and in research. Understanding the acoustic and pathologic variables that can affect auditory evoked potentials (latency, amplitude, and morphology) and otoacoustic emissions is paramount.

Course Structure: All notes and ancillary materials will be posted on D2L. Material will be discussed in class in the form of structured lectures and discussions. Student discussion will contribute importantly to understanding of various topics. You are expected to participate. Notification: if the instructor believes necessary, students will be warned that some course content may be deemed offensive by some students.

The lab sessions will give participants the opportunity to learn proper technique for obtaining high quality auditory evoked potentials and otoacoustic emissions.

Students will be assessed on the basis of the 3 written assignments/exams and a final examination (4 total). This class must be taken concurrently with the 588L Lab. There will be no written exam for the lab practicum, but there will be writing and practical assignments which must be completed on schedule to receive a passing grade in lab.

Learner Outcomes: As a result of completing the assigned reading, attending lecture and participating in discussion and labs the learner will be able to:

1) Define the principles of signal processing for auditory evoked potentials and OAEs.
2) Determine the amount of amplification, number of averages, filtering requirements and the artifact reject levels needed to obtain the ABR (+ RF Chirp), ASSR, ECoG, TEOAEs and DPOAEs.
3) Define the neural generators of the ABR, ASSR, ECochG, and of spontaneous and evoked OAE suppression effects.
4) Discuss the stimulus variables that affect the latency and amplitude of ABR, ASSR, ECochG, and evoked OAEs.
5) Discuss the subject-related variables, including subject state and age, that affect the latency and amplitude of the ABR, ASSR, ECochG, spontaneous and evoked OAEs.
6) Summarize the effect of hearing loss and nervous system pathology on the ABR, ASSR, ECochG, spontaneous and evoked OAEs and their suppression.
7) Analyze each of the evoked potentials and OAEs in the time or frequency domain, as appropriate.
8) Analyze, interpret and summarize the results of ABR, ASSR, ECochG, RF Chirp and evoked OAE tests.
9) Compose/prescribe ABR, ASSR, ECochG, RF Chirp and OAE test protocols that can be used clinically.
10) Critique the literature pertaining to clinical applications of ABR, ECochG, ASSR, RF-Chirp & OAE tests.
11) Perform, analyze, interpret and summarize an ABR, ECochG, ASSR, RF-Chirp and OAE test on a normally-hearing adult.

Weighting of Assignments/Exams
3 Written assignments/exams during the semester = 50 points each.
Final Comprehensive Exam = 100 pts

The written assignments/exams may be given as take-home assignments. At least one week advance notice will be given when this occurs.

Grading Scale:
90%-100% = A
80-89% = B
70-79% = C
≤ 70% Don’t go there…

If you are having difficulty with the material or are concerned about your progress, then PLEASE see me. I’m happy to work with you to find learning methods to reinforce the material. Don’t WAIT!!

Grade Revision: With the exception of the final exam, students have 7 days from the posting of exam scores on D2L to dispute a grade. For the final exam, students will have 2 days from the posting of exam scores on D2L to dispute a grade before the final grades are submitted.

Confidentiality of Student Records: http://www.registrar.arizona.edu/ferpa/default.htm

REQUIRED texts are:

OAE text will be announced soon
There may be other book chapters and journal articles. These will posted on D2L. You will be responsible for their content.

**Recommended texts: Not required, but may be useful to you...**


**Attendance Policy:** This is a graduate course, you are expected to attend class sessions. If you are unable to attend class, then you must notify me. If you miss class material, then it is your responsibility to obtain the information from your classmates.

- All holidays or special events observed by organized religions will be honored for those students who show affiliation with that particular religion.
- Absences pre-approved by the UA Dean of Students (or Dean's designee) will be honored

**Classroom Behavior:** Please turn off all cell phones PLEASE DO NOT TEXT IN CLASS (I can tell…). If you MUST take a call, please step out of the room. Laptops may be used for note taking or locating material related to material presented in class.

- Plagiarism within the Student Code of Academic Integrity: [http://deanofstudents.arizona.edu/codeofacademicintegrity](http://deanofstudents.arizona.edu/codeofacademicintegrity)
- Threatening behavior by students: [http://policy.web.arizona.edu/threatening-behavior-students](http://policy.web.arizona.edu/threatening-behavior-students)

**Academic Integrity:** Course participants are expected to adhere to the University Of Arizona Code Of Academic Integrity. Requirements of the code may be found at: [http://deanofstudents.arizona.edu/codeofacademicintegrity](http://deanofstudents.arizona.edu/codeofacademicintegrity)

**Special Needs and Accommodations Statement:** Students who need special accommodation or services should contact the Disability Resources Center, 1224 East Lowell Street, Tucson, AZ 85721, (520) 621-3268, FAX (520) 621-9423, email: uadrc@email.arizona.edu, http://drc.arizona.edu/. You must register and request that the Center or DRC send me official notification of your accommodations needs as soon as possible. Please plan to meet with me by appointment or during office hours to discuss accommodations and how my course requirements and activities may impact your ability to fully participate. The need for accommodations must be documented by the appropriate office.
Subject to Change Statement: Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.

Lecture Schedule: This schedule is a guideline. Adjustments will likely be made as the semester progresses. If exam times change, you will have at least 1 week’s notice and they will always change to a later time period.


   Textbook: Chapter 1, Introduction: Past, Present and Potential (Picton)

Wed 26 August: Signal Processing I: Bio-electric safety. Principles of signal averaging in the time and frequency domains

   Textbook: Chapter 2 Recording Evoked Potentials: Means to an End (Picton)

Mon 31 August: Signal Processing II: Filters, amplifiers, artifact reject

   Textbook: Chapter 2 Recording Evoked Potentials: Means to an End (Picton)

Wed 02 September: ABR I: Neural Generators, neural substrates

   Textbook: Chapter 4 Finding Sources: Forward and Backward (Picton)

Mon 07 September: Labor Day, No Class

Wed 09 September: ABR II: Normal click evoked response, effect of level

   Textbook: Chapter 2 Recording Evoked Potentials: Means to an End (Picton)

   Reading: Handout: Calibration of clicks from Glattke, T.J. Short-latency auditory evoked potentials, AEPs chapter 3 (Durrant and Boston)

Mon 14 September: ABR III: Non pathologic variables; gender, aging, montage, rise-time, rate, tone-bursts

   Textbook: Chapter 8 Auditory Brainstem: Peaks Along the Way (Picton)

Wed 16 September: ABR IV: Recording ABR to tone bursts

   Textbook: Chapter 8 Auditory Brainstem: Peaks Along the Way (Picton)

Reading: New Handbook of AEPs (Hall) Chapters 7, 10 Handout

**Wed 23 September** ABR VI, Pathology: Effects of neural and retrocochlear disorders.

Textbook: Chapter 14 Neurotology and Neurology: From Cochlea to Cortex (Picton)

**Mon 28 September:** ABR VII: Effects of Maturation Estimation of thresholds in infants and children, predicting the audiogram with tone evoked responses.

Textbook: Infant Hearing Assessment: Opening Ears (Picton)

**Wed 30 September:** **Written Assignment Exam I**

**Mon 05 October:** ABR VIII Automatic detection algorithms, Fsp, newborn hearing screening applications, Rising Frequency Chirp.

Textbook: Chapter 6 Interpreting the Waveforms: Time and Uncertainty (Picton)

**Wed 07 October:** ABR IX: Wrap up with ABR; Bone-conduction responses.

Handout: ABR Bone Conduction Tests (Cone-Wesson)

**Mon 12 October:** Case Interpretation Discussion


**Wed 14 October:** ASSR I Neural generators, stimulus-response characteristics

Textbook: Chapter 3 Frequency Domain: Music of the Hemispheres
Chapter 10 Auditory Steady State Responses and Following Responses: Dancing to the Rhythms (Picton)

**Mon 19 October:** ASSR II Detection algorithms, phase coherence

Reading: Cone-Wesson and Dimitrijevic (Handout)

**Wed 21 October:** ASSR III Multi-frequency techniques, comparison of methods. Clinical applications

**Mon 26 October:** Review ABR/ASSR
Wed 28 October **Written Assignment/Exam II (ABR and ASSRs).**

**Mon 02 November:** ECochG I: Physiology of cochlear potentials: cochlear microphonic, summing potentials, compound action potential. ECOG II: Stimulus-response characteristics, technical variables, effects of hearing loss.

Reading: AEPs Chapter 9 (Schoonhoven)

**Wed 04 November:** ECochG II: Stimulus-response characteristics, technical variables, effects of hearing loss. ECochG III: Effects of hearing loss; ECOG and endolymphatic hydrops

Textbook: Chapter 7 Electrocochleography: From Song to Synapse  
Supplemental reading: Hall New Handbook: Chapters 4 and 5

**Mon 09 November:** Electrically Evoked AEPs: ECAP (NRT)

Textbook: Cochlear Implants: Body Electric


**Wed 11 November:** Electrically evoked AEPs: ABR (maybe MLR and CAEP)

**Mon 16 November** OAE I, Origins and potential applications of OAE measurements.

Reading: Robinette and Glattke, 3rd Edition Chapters 1 (Kemp) and 2 (Ryan)

**Wed 18 November** OAE II, SOAEs,

Reading: Robinette and Glattke, 3rd Edition Chapter 3 (Bright), Chapter 7 (Keefe)
Mon 23 November: OAE III, TEOAE

Reading: Robinette and Glattke, 3rd Edition, Chapter 4 (Glattke and Robinette), Chapter 9 (Robinette, Cevette & Probst)

Wed 25 November OAE IV: DPOAEs,

Reading: Robinette and Glattke, 3rd Edition, Chapter 5 (Lonsbury-Martin and Martin), Chapter 8 (Gorga et al)

Mon 30 November OAE V: Suppression of OAEs, OAE VI Differential Diagnosis/Pathology

Reading: Robinette and Glattke, 3rd Edition, Chapter 6 (Velenovsky and Glattke) and Chapter 11 (Hood), Robinette and Glattke, 3rd Edition, Chapter 10 (Durrant and Collet)

Wed 02 December Written Assignment/Exam III (OAEs)

Mon 07 December OAE VII + OAE VIII: Special Populations: Neonates, Children

Reading: Robinette and Glattke, 3rd Edition, Chapter 13 (Prieve) and Chapter 14 (Widen)

Wed 09 December Finish up...

Lab Schedule: This listing is a guide

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<thead>
<tr>
<th>Date</th>
<th>Lab Listing</th>
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<tbody>
<tr>
<td>08/24</td>
<td>Week 1 NO LAB</td>
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<tr>
<td>08/31</td>
<td>Week 2 ABR Lab I The basics</td>
</tr>
<tr>
<td>09/07</td>
<td>Week 3 ABR Lab II Stimulus calibration, psychophysics of clicks</td>
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<tr>
<td>09/14</td>
<td>Week 4 ABR Lab III Affect of stimulus and recording parameters</td>
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<tr>
<td>09/21</td>
<td>Week 5 ABR Lab IV Tone bursts</td>
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<tr>
<td>09/28</td>
<td>Week 6 Lab TBA</td>
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<tr>
<td>10/05</td>
<td>Week 7 ABR Lab V Rising Frequency Chirp, and bone cond. ABR</td>
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<td>10/12</td>
<td>Week 8 Lab ASSR</td>
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<tr>
<td>10/19</td>
<td>Week 9 Lab TBA</td>
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<td>10/26</td>
<td>Week 10 ECochG Lab</td>
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<tr>
<td>11/02</td>
<td>Week 11 OAE Lab I TEOAE: reading the screen, interpretation</td>
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<tr>
<td>11/09</td>
<td>Week 12 OAE Lab II TEOAE continued</td>
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<tr>
<td>11/16</td>
<td>Week 13 TEOAEs Continued</td>
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<tr>
<td>11/23</td>
<td>Week 14 OAE Lab III DPOAE</td>
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<tr>
<td>11/30</td>
<td>Week 15 No Lab or catch up</td>
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Final Exam: Wednesday 12/16/2015 1:00 pm - 3:00 pm
### Standard IV-A: Foundations of Practice
The applicant must have knowledge and skills in:

| A1. Embryology and development of the auditory and vestibular systems, anatomy and physiology, neuroanatomy and neurophysiology | Yes |
| A2. Genetics and associated syndromes related to hearing and balance | Yes |
| A3. Normal aspects of auditory physiology and behavior over the life span | Yes |
| A4. Normal development of speech and language | Yes |
| A5. Language and speech characteristics and their development across the life span | Yes |
| A6. Phonologic, morphologic, syntactic, and pragmatic aspects of human communication associated with hearing impairment | Yes |
| A7. Effects of hearing loss on communication and educational, vocational, social, and psychological functioning | Yes |
| A8. Effects of pharmacologic and teratogenic agents on the auditory and vestibular systems | Yes |
| A9. Patient characteristics (e.g., age, demographics, cultural and linguistic diversity, medical history and status, cognitive status, and physical and sensory abilities) and how they relate to clinical services | Yes |
| A10. Pathologies related to hearing and balance and their medical diagnosis and treatment | Yes |
| A11. Principles, methods, and applications of psychometrics | Yes |
| A12. Principles, methods, and applications of psychoacoustics | Yes |
| A13. Instrumentation and bioelectrical hazards | Yes |
| A14. Physical characteristics and measurement of electric and other nonacoustic stimuli | Yes |
| A15. Assistive technology | Yes |
| A16. Effects of cultural diversity and family systems on professional practice | Yes |
| A17. American Sign Language and other visual communication systems | Yes |
| A18. Principles and practices of research, including experimental design, statistical methods, and application to clinical populations | Yes |
| A19. Legal and ethical practices (e.g., standards for professional conduct, patient rights, credentialing, and legislative and regulatory mandates) | Yes |
| A20. Health care and educational delivery systems | Yes |
| A21. Universal precautions and infectious/contagious diseases | Yes |
| A22. Oral and written forms of communication | Yes |
| A23. 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: a. occupational and industrial environments b. community noise c. classroom and other educational environments d. workplace environments | Yes |
| A24. The use of instrumentation according to manufacturer’s specifications and recommendations | Yes |
| A25. Determining whether instrumentation is in calibration according to accepted standards | Yes |
| A26. Principles and applications of counseling | Yes |
| A27. Use of interpreters and translators for both spoken and visual communication | Yes |
| A28. Management and business practices, including but not limited to cost analysis, budgeting, coding and reimbursement, and patient management | Yes |
| A29. Consultation with professionals in related and/or allied service areas | Yes |

### Standard IV-B: Prevention and Identification
The applicant must have knowledge and skills in:

| B1. Implement activities that prevent and identify dysfunction in hearing and communication, balance, and other auditory-related systems | Yes |
| B2. Promote hearing wellness, as well as the prevention of hearing loss and protection of hearing function by designing, implementing, and coordinating universal newborn hearing screening, school screening, community hearing, and occupational conservation and identification programs | Yes |
| B3. Screen individuals for hearing impairment and disability/handicap using clinically appropriate, culturally sensitive, and age- and site-specific screening measures | Yes |
| B4. Screen individuals for speech and language impairments and other factors affecting communication function using clinically appropriate, culturally sensitive, and age- and site-specific screening measures | Yes |
| B5. Educate individuals on potential causes and effects of vestibular loss | Yes |
| B6. Identify individuals at risk for balance problems and falls who require further vestibular assessment and/or treatment or referral for other professional services | Yes |

### Standard IV-C: Assessment
The applicant must have knowledge and skills in:

| C1. Measuring and interpreting sensory and motor evoked potentials, electromyography, and other electrodiagnostic tests for purposes of neurophysiologic intraoperative monitoring and cranial nerve assessment | Yes |
| C2. Assessing individuals with suspected disorders of hearing, communication, balance, and related systems | Yes |
| C3. Evaluating information from appropriate sources and obtaining a case history to facilitate assessment planning | Yes |
| C4. Performing otoscopy for appropriate audiological assessment/management decisions, determining the need for cerumen removal, and providing a basis for medical referral | Yes |
| C5. Conducting and interpreting behavioral and/or electrophysiologic methods to assess hearing thresholds and auditory neural function | Yes |
| C6. Conducting and interpreting behavioral and/or electrophysiologic methods to assess balance and related systems | Yes |
| C7. Conducting and interpreting otoacoustic emissions and acoustic immittance (reflexes) | Yes |
| C8. Evaluating auditory-related processing disorders | Yes |
| C9. Evaluating functional use of hearing | Yes |
| C10. Preparing a report, including interpreting data, summarizing findings, generating recommendations, and developing an audiologic treatment/management plan | Yes |
| C11. Referring to other professions, agencies, and/or consumer organizations | Yes |
### Standard IV-D: Intervention (Treatment)
The applicant must have knowledge and skills in:

**D1.** The provision of intervention services (treatment) to individuals with hearing loss, balance disorders, and other auditory dysfunction that

**D2.** Development of a culturally appropriate, audiologic rehabilitative management plan that includes, when appropriate, the following:

- a. Evaluation, selection, verification, validation, and dispensing of hearing aids, sensory aids, hearing assistive devices, alerting systems, and captioning devices, and educating the consumer and
- b. Determination of candidacy of persons with hearing loss for cochlear implants and other implantable sensory devices and provision of fitting,
- c. Counseling relating to psychosocial aspects of hearing loss and other auditory dysfunction, and processes to enhance communication
- d. Provision of comprehensive audiologic treatment for persons with hearing loss or other auditory dysfunction, including but not exclusive to communication strategies, auditory training, speech reading, and

**D3.** Determination of candidacy for vestibular and balance rehabilitation therapy to persons with vestibular and balance impairments

**D4.** Treatment and audiologic management of tinnitus

**D5.** Provision of treatment services for infants and children with hearing loss; collaboration/consultation with early interventionists, school based professionals, and other service providers regarding development of intervention plans (i.e., individualized education programs and/or

**D6.** Management of the selection, purchase, installation, and evaluation of large-area amplification systems

**D7.** Evaluation of the efficacy of intervention (treatment) services

### Standard IV-E: Advocacy/Consultation
The applicant must have knowledge and skills in:

**E1.** Educating and advocating for communication needs of all individuals that may include advocating for the programmatic needs, rights, and funding of services for those with hearing loss, other auditory

**E2.** Consulting about accessibility for persons with hearing loss and other auditory dysfunction in public and private buildings, programs, and

**E3.** Identifying underserved populations and promoting access to care

### Standard IV-F: Education/Research/Administration
The applicant must have knowledge and skills in:

**F1.** Measuring functional outcomes, consumer satisfaction, efficacy, effectiveness, and efficiency of practices and programs to maintain and improve the quality of audiologic services

**F2.** Applying research findings in the provision of patient care (evidence-based practice)

**F3.** Critically evaluating and appropriately implementing new techniques and technologies supported by research-based evidence

**F4.** Administering clinical programs and providing supervision of professionals as well as support personnel

**F5.** Identifying internal programmatic needs and developing new programs

**F6.** Maintaining or establishing links with external programs, including but not limited to education programs, government programs, and philanthropic agencies