

**GOVERNORS STATE UNIVERSITY
COLLEGE OF HEALTH PROFESSIONS
DEPARTMENT OF COMMUNICATION DISORDERS**

COURSE SYLLABUS

COURSE NO: CDIS 330

COURSE TITLE: Speech and Hearing Science

INSTRUCTOR: William S. Yacullo, Ph.D.
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CREDIT HOURS: 3

TERM: Fall 2003

PREREQUISITES: None

COURSE DESCRIPTION

Speech and hearing science refers to the body of scientific information relevant to sound, the auditory system, physiological and psychological responses to sound, and processes involved in the production and perception of speech. A broad base of knowledge in speech and hearing science is essential in the study of communication disorders. This course includes the study of physical concepts, acoustics, measurement of sound, and psychophysical methods. Topics in psychoacoustics, acoustic phonetics, and speech perception are examined. Laboratory experiences complement classroom topics.

CERTIFICATION STANDARDS

Satisfactory completion of this course is intended to assist students in meeting the following sections of the ASHA Standards for the Certificate of Clinical Competence in Speech-Language Pathology, effective January 1, 2005.

- Standard III-C: The applicant must demonstrate knowledge of basic human communication and swallowing processes, including their biological, neurological, acoustic, psychological, developmental, and linguistic and cultural bases.



REQUIRED TEXTS

Speaks, C.E. (1999). *Introduction to Sound, Acoustics for the Hearing and Speech Sciences* (3rd ed.). San Diego, CA: Singular.

Yacullo, W. (2002). *Speech and Hearing Science Notebook*. Governors State University.

Yacullo, W. (2001). *Auditory Demonstrations Laboratory*. Governors State University.

SUPPLEMENTARY TEXTS

Durrant, J., and Lovrinic, J. (1995). *Bases of Hearing Science* (3rd ed.). Baltimore, MD: Williams & Wilkins.

Gelfand, S. A. (2001). *Essentials of Audiology* (2nd ed.) New York: Thieme.

Gelfand, S. A. (1998). *Hearing: An Introduction to Psychological and Physiological Acoustics*. New York: Marcel Dekker, Inc.

Pickett, J. M. (1999). *The Acoustics of Speech Communication: Fundamentals, Speech Perception Theory, and Technology*. Boston: Allyn & Bacon.

Ross, M., and Giolas, T. (1978). *Auditory Management of Hearing Impaired Children* Baltimore, MD: University Park Press.

Small, A. (1978). *Elements of Hearing Science: A Programmed Text*. New York: John Wiley & Sons, Inc.

EXPECTED STUDENT OUTCOMES

Upon completion of this course, the student will be able to:

- 1) Describe the process of sound generation and transmission.
- 2) Differentiate periodic and aperiodic sound vibration.
- 3) Specify characteristics of sound in terms of amplitude, frequency, and time.
- 4) Quantify the magnitude of sound using decibel notation.
- 5) Describe the basic components of impedance.
- 6) Describe the concept of acoustic resonance.
- 7) Describe and identify major uses of basic electroacoustic instrumentation for measurement and analysis of sound.
- 8) Describe classic and adaptive procedures for measurement of psychological response to sound.
- 9) Describe basic psychological responses to acoustic stimulation.
- 10) Describe the acoustic characteristics of speech and the cues important to speech perception

LEARNING ACTIVITIES

- 1) **Lectures.**
- 2) **Demonstrations** complement classroom topics.
- 3) **Homework Problem Sets.**

Homework problem sets (5) are used to facilitate an understanding of basic physical concepts in acoustics. They are available in CDIS 330 Speech and Hearing Science Notebook.

4) **Auditory Demonstrations Laboratory**

You will be listening to a series of auditory demonstrations that were prepared at the Institute for Perception Research (IPO), Eindhoven, The Netherlands. These audio materials were developed for the purpose of demonstrating psychoacoustic phenomena. The demonstrations have been recorded on compact disc; copies are available for a one-week loan period from the GSU Library. The CD must be listened to through stereo headphones. You can use either your own CD player or a CD player available in the Communication Disorders Laboratory (F1617).

A more detailed description of the Listening Laboratory is presented in the laboratory materials Auditory Demonstrations Laboratory. Each auditory demonstration is accompanied by text, commentary, and a series of questions. You are required to answer the questions for each demonstration.

NOTE: This is an independent study project. Students are expected to complete this project independently, not in collaboration with other students. Although this activity is considered self-instructional, you are strongly encouraged to meet with the instructor whenever clarification of material is required. Students who are repeating the course are not required to repeat the Auditory Demonstrations Laboratory.

COURSE REQUIREMENTS

- 1) Required readings.
- 2) Two midterm examinations.
- 3) Final examination.
- 4) Homework problems.
- 5) Auditory Demonstrations Laboratory.

EVALUATION The final grade will be based on:

Midterm examination 1.....	27.5%
Midterm examination 2.....	27.5%
Final examination.....	35%
Listening Laboratory.....	10%

If an examination cannot be taken due to illness or emergency, the student must notify the instructor in advance. Failure to notify the instructor will result in a failing grade on the examination.

GRADING The following letter grades shall be used:

A	Course average of	90 – 100%
B	Course average of	80 – 89%
C	Course average of	70 – 79%
D	Course average of	60 – 69%
F	Course average of	less than 60%

Extra-credit work for the purpose of raising a course grade is not permitted. In accordance with university policy, course grades are assigned using evaluation criteria stated in the course syllabus.

DATES TO REMEMBER:

September 25, 2003	Midterm Examination 1
October 23, 2003	Midterm Examination 2
November 20, 2003	Laboratory is due *
December 4, 2003	Final Examination**

***Your laboratory must be turned in on time. The grade on the laboratory project will be lowered by one letter grade (10 points) for each week that it is late. Projects that are more than one week late will not be accepted for credit.**

**** If a class is canceled during the trimester because of weather or emergency, the final examination will be postponed until 12/11/03.**

SERVICES FOR STUDENTS WITH DISABILITIES:

Students who have a disability or special needs and require accommodation in order to have equal access to the classroom, must register with the designated staff member in the Division of Student Development. Please go to Room B1201 or call 708/534-4090 and ask for the Coordinator of Disability Services. Students will be required to provide documentation of any disability when an accommodation is requested.

COURSE OUTLINE/SCHEDULE

- 8/28/03** I. Physical Concepts
- A. Scientific notation
 - B. Physical quantities
 - 1. Vectorial/Scalar quantities
 - 2. Dimensions of magnitude
 - 3. Metric subsystems
 - a. MKS
 - b. CGS
 - 4. Basic physical quantities
 - a. time
 - b. mass
 - c. length
 - C. Motion
 - 1. Newton's Laws of Motion
 - 2. Displacement
 - 3. Velocity
 - 3. Acceleration
- 9/4/03** D. Energy
 - 1. Kinetic energy
 - 2. Potential energyE. Spring-Mass System
- F. Simple Harmonic Motion
- 9/11/03** G. Characteristics of a Sinusoid
 - 1. Frequency
 - 2. Amplitude
 - 3. PhaseH. Introduction to the Oscilloscope
- I. Free and Forced Vibrations
- J. Impedance
 - 1. Resistance
 - 2. Reactance
 - a. mass
 - b. stiffness
- 9/18/03** II. Acoustics
- A. Sound Transmission
 - B. Sound Pressure and Intensity
 - C. Interference with Sound Transmission
 - 1. Reflection
 - 2. Absorption
 - 3. Diffraction
 - 4. Sound Shadow

- 9/25/03** **[Midterm Examination 1]**
- II. Acoustics (continued)
 - D. Soundfields
 - 1. Free field
 - 2. Reverberant field
 - E. Acoustic Resonance
 - F. Standing Waves
- 10/2/03** **III. Measurement and Specification of Sound**
- A. Amplitude
 - 1. Peak amplitude
 - 2. Peak-to-peak amplitude
 - 3. RMS amplitude
 - B. The Decibel
 - 1. Decibel notation
 - 2. Sound pressure level
 - 3. Intensity level
 - 4. Sensation level
 - C. Combination of Sounds
 - D. Inverse Square Law
- 10/9/03** **E. Measurement and Analysis of Sound**
- 1. Periodic/Aperiodic Vibration
 - 2. Spectrum Analysis
 - a. fundamental frequency
 - b. harmonics
 - 3. Filters
 - a. high-pass
 - b. low-pass
 - c. band-pass
 - 4. Sound Level Meter
- 10/16/03** **IV. Introduction to Psychoacoustics**
- A. Threshold
 - B. Absolute Auditory Sensitivity
 - 1. Effects of frequency
 - 2. Effects of duration

10/23/03

[Midterm Examination 2]

- C. Differential Auditory Sensitivity
 - 1. Intensity
 - 2. Frequency
 - 3. Duration
- D. Beats
- E. Masking
 - 1. Critical band theory
 - 2. Temporal masking
 - a. simultaneous masking
 - b. forward masking
 - c. backward masking

10/30/03

- F. Loudness
 - 1. Equal loudness contours
 - 2. Scaling of loudness
 - 3. Adaptation and fatigue
- G. Pitch
- H. Binaural Hearing
 - 1. Localization
 - 2. Lateralization
 - 3. Masking level difference

11/6/03

V. Speech Production, Acoustics, and Perception

- A. Introduction
 - 1. Acoustic Phonetics
 - a. Speech production
 - b. Speech acoustics
 - 2. Speech Perception
- B. Source - Filter Theory
 - 1. Tube model
 - 2. Types of sound sources
 - a. periodic
 - b. random
 - c. transient
- C. Vowel Sounds
 - 1. Sound Source and Spectral Characteristics
 - 2. Source - Filter Theory of Vowel Production
 - a. Neutral vowel
 - b. Formants
 - 3. Vowel Formant Locations and Length of Pharyngeal-Oral Tract
 - 4. Vocal Tract Constrictions and Formant Frequency Locations

- 11/13/03
- D. Acoustic Analysis of Speech
 - 1. Spectrographic Analysis of Speech
 - 2. Spectrogram
 - 3. Procedures for Estimating Formant Frequencies
 - E. Spectrograms of Vowels
 - F. Acoustic Cues for Identification of Vowels
 - 1. Vowels
 - 2. Diphthongs
 - G. Consonant Sounds
 - 1. Consonant versus Vowel Production
 - 2. Articulatory Features
 - a. Manner of articulation
 - b. Place of articulation
 - c. Voicing
 - 3. Fricatives
 - a. Production
 - b. Acoustic cues for identification
- 11/20/03
- [Auditory Demonstrations Laboratory Due]**
- 4. Stops
 - a. Production
 - b. Acoustic cues for identification
 - c. Acoustic cues for voicing
 - H. Frequency and Intensity Characteristics of Speech
 - 1. Short-term versus long-term spectrum
 - 2. Power of Speech Sounds
 - 3. Frequency Characteristics of Speech Sounds
 - 4. Speech intelligibility
 - a. Intensity effects
 - b. Contribution of different frequency ranges
- 11/27/03
- THANKSGIVING
NO CLASS**
- 12/4/03
- [FINAL EXAMINATION]**
- 12/11/03
- If a class is canceled during the trimester because of weather or emergency, the final examination will be postponed until 12/11/03.**

READING LIST

I. Physical Concepts

Scientific notation, units of measurement, force, work, energy, power, mass, velocity, acceleration, elasticity, friction, spring-mass system.

- *Speaks, C. (1999). Chapter 1, The Nature of Sound Waves, *Introduction to Sound*, pp. 1-34.
- *Yacullo, W. (2001). Problem Set #1, *Speech and Hearing Science Notebook*, pp. 31-34.
- *Yacullo, W. (2001). Problem Set #2, *Speech and Hearing Science Notebook*, pp. 35-40.
- Small, A. (1978). "Exponents," Chapter 1, *Elements of Hearing Science*, pp. 3-27.
- **Durrant, J., and Lovrinic, J. (1995). "Physical Concepts," Chapter 1, *Bases of Hearing Science*, pp. 1-16.

I. Physical Concepts (continued)

Simple harmonic motion, sinusoids, frequency, period, amplitude, phase, free vibration, forced vibration, impedance.

- *Speaks, C. (1999). Chapter 2, Simple Harmonic Motion, *Introduction to Sound*, pp. 45-93.
- *Yacullo, W. (2001). Problem Set #3, *Speech and Hearing Science Notebook*, pp. 41-44.
- **Durrant, J., and Lovrinic, J. (1995). "Physical Concepts," Chapter 1, *Bases of Hearing Science*, pp. 17-29.

II. Acoustics

Sound generation, sound transmission, condensation, rarefaction, wave-length, sound pressure, sound intensity, inverse square law, characteristic impedance, reflection, absorption, reverberation, sound shadow, diffraction, constructive interference, destructive interference, standing waves, acoustic resonance.

- *Speaks, C. (1999). Chapter 1, The Nature of Sound Waves, *Introduction to Sound*, pp. 34-43.
- *Speaks, C. (1999). Chapter 8, Sound Transmission, *Introduction to Sound*, pp. 251-300.
- *Yacullo, W. (2001). Problem Set #4, *Speech and Hearing Science Notebook*, pp. 71-76.
- **Durrant, J., and Lovrinic, J. (1995). "Acoustics," Chapter 2, *Bases of Hearing Science*, pp. 31-62.

***Required**

****Supplementary**

III. Specification and Measurement of Sound

Peak amplitude, peak-to-peak amplitude, RMS amplitude, sound level meter, the decibel, periodic sound, aperiodic sound, spectrum level, spectrum analysis, filtering, linearity, distortion.

*Speaks, C. (1999). Chapter 3, Logarithms and Antilogarithms, *Introduction to Sound*, pp. 95-120.

*Speaks, C. (1999). Chapter 4, Sound Intensity and Sound Pressure: The Decibel, *Introduction to Sound*, pp. 121-152.

*Yacullo, W. (2001). Problem Set #5, *Speech and Hearing Science Notebook*, pp. 100-108.

*Speaks, C. (1999). Chapter 5, Complex Waves, *Introduction to Sound*, pp. 153-181.

*Speaks, C. (1999). Chapter 6, Resonance and Filtering, *Introduction to Sound*, pp. 183-230.

**Durrant, J., and Lovrinic, J. (1995). "Measurement of Sound," Chapter 3, *Bases of Hearing Science*, pp. 63-101.

Small, A. (1978). "Logarithms and Antilogarithms," Chapter 2, *Elements of Hearing Science*, pp. 28-42.

Small, A. (1978). "Ratios," Chapter 3, *Elements of Hearing Science*, pp. 43-54.

Small, A. (1978). "Decibels," Chapter 4, *Elements of Hearing Science*, pp. 55-70.

IV. Introduction to Psychoacoustics

*Gelfand, S. A. (2001). Measurement and Principles and the Nature of Hearing, Chapter 3. *Essentials of Audiology*, pp. 91 – 117.

**Small, A. (1978). "Traditional Psychophysical Methods," Chapter 6, *Elements of Hearing Science*, pp. 101-130.

**Small, A. (1978). "Beats," Chapter 7, *Elements of Hearing Science*, pp. 133-153.

**Durrant, J., and Lovrinic, J. (1995). "Introduction to Psychoacoustics," Chapter 7, *Bases of Hearing Science*, pp. 256-312.

**Gelfand, S. A. (1998). *Hearing: An Introduction to Psychological and Physiological Acoustics*. New York: Marcel Dekker, Inc.

V. Speech Production, Acoustics, and Perception

- *Levitt, H. (1978). "The Acoustics of Speech Production," *Auditory Management of Hearing Impaired Children*, edited by M. Ross and T. Giolas. University Park Press, Baltimore, Maryland, pp. 45-104.
- *Pickett, J. M. (1999). "Vowel Shaping and Vowel Formants," Chapter 3. *The Acoustics of Speech Communication*, pp. 35 – 46.
- *Pickett, J.M. (1999). "The Glottal Sound Source and the Spectra of Vowels," Chapter 4. *The Acoustics of Speech Production*," pp. 57 – 62, 68-70.

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