

## **Purdue University Hearing & Acoustics Classes**

*compiled October 2006*

*Please note: Not all courses listed here are offered at the graduate level (usually 500 or above), but some may be helpful for those wishing to cross disciplines to further their training in engineering or life sciences fields. Students should consult their own programs to determine which courses may be counted towards a graduate degree in their program of study. Students should consult the professor teaching the course for waiver of prerequisites, particularly if the course is outside of the student's area of expertise or specific program of study.*

### **A&AE 301 - Signal Analysis for Aerospace Engineering**

Credits: 3.00

Signal processing and spectral analysis for aerospace engineering. Fourier and fast Fourier transforms. Vibration analysis; estimation of natural frequencies, wing vibrations. Introduction to linear circuits, operational amplifiers and filtering. Noise suppression.

Prerequisite: MA 265, 266. Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **A&AE 340 - Dynamics and Vibrations**

Credits: 3.00

Kinematics and kinetics of particles and rigid bodies. Topics include a particle in orbit, systems of particles, vibrations, Euler's equations of motion, Eulerian angles, and aerospace vehicle dynamics.

Prerequisite: MA 303 or MA 304. Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **A&AE 552 - Nondestructive Evaluation of Structures and Materials**

Credits: 3.00

Overview of methods employed for nondestructive evaluation of structures and materials taught in the context of damage tolerant structural analysis. Major inspection topics include: radiography, ultrasonics, eddy current, penetrant, magnetic, and visual/optical techniques. Other new emerging inspection techniques also are discussed. Offered in alternate years.

Prerequisite: A&AE 204 or C E 273. Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **A&AE 615 – Aeroacoustics**

see M E 615

### **BIOL 562 / PSY 512 – Neural Systems**

Credits: 3.00

The course will focus on questions regarding how the functions of the individual cellular components of the nervous system are integrated in the brain and nervous system to produce behavior and higher mental functions. The course will address the structure and function of specific neural system, such as the motor, somatosensory, visual and auditory systems, learning and memory and higher cortical function. It will combine and integrate molecular and cellular biology of the nervous system with the relevant neuroanatomy.

Prerequisite: BIOL 495N encouraged. Background in cell biology, psychobiology, physiology or anatomy is recommended. Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **BIOL 595G - Animal Communication**

Credits: 3.00

This will be a broad-scaled analysis of animal communication. Topics will include the physics of sound- and light-signal production, propagation and reception of signals, the use of communication as a means of information transfer, and the evolution of signaling systems.

Rerequisites: None. Some mathematical principles will be covered (e.g. in the evolution of signals), so some background in mathematics (e.g. calculus or algebra and introductory physics) would be helpful.

### **BME 305 – Bioinstrumentation**

Credits: 2.00

Introduction of laboratory instruments used to measure physiological events. Stimulation and conduction of electric signals within the mammalian nervous system and other excitable tissues are demonstrated. Fundamental circuit elements and concepts include resistance, capacitance, inductance, op-amps, impedance, voltage, current, power, and frequency. Integrative design project addresses instrumentation amplifiers and filtering for obtaining an ECG, emphasizing the practical aspects of quantitative physiological measurements.

Registration Approval: Department approval is required.

### **BME 528 - Measurement and Stimulation of the Nervous System**

see ECE 528

### **BME 581 - Fundamentals of MEMS and Micro-Integrated Systems**

see ECE 526

### **BME 595B - Biomedical Signal Processing**

Credits: 3.00

Introduction to the application of digital signal processing to practical problems involving biomedical signals and systems. Topics include: biomedical signals; concurrent, coupled, and correlated processes; filtering for removal of artifacts; event detection; waveshape

and waveform complexity; frequency domain characterization; modeling biomedical systems; analysis of nonstationary signals; pattern classification and diagnostic decision.

**Prerequisites:** ECE 301 and ECE 302 (or permission of instructor). Familiarity with MATLAB

### **BME 695M - Computational Modeling of Hearing Impairment**

Credits: 1.00

This course is designed primarily for specialized topic areas for which there is no specific course, workshop, or individual study plan, but having enough student interest to justify the formalized teaching of an advanced course.

Prerequisite: Department approval is required.

### **C E 350 - Environmental Engineering**

Credits: 3.00

Introduction to water pollution, air pollution, noise, hazardous and solid wastes, and their control. Environmental impact statements and global pollution issues. Field trips required.

Prerequisite: [CHM 116](#). Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **CGT 346K - Digital Video & Audio**

Credits: 3.00

Covers the use of digital technologies for video and audio in multimedia, hypermedia, and animation products. Students examine the methods for creating, sampling, and storing digital video and digital audio and the constraints placed on these media assets when used for media-based products. Emphasis is placed upon the technology of digital video and audio, including formats, data rates, compressors, and the advantages and disadvantages of the different technologies.

Prerequisite: [CGT 241](#). Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **COM 435 - Communication and Emerging Technologies**

Credits: 3.00

Both historical and contemporary perspectives of the reciprocal influence of new and changing technologies and the processes and practices of communication. The impact of print, telegraph, telephone, radio, and television will be surveyed, along with cable systems, direct broadcast satellites, and videotext.

Prerequisites: [COM 114](#), [250](#). Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **EAS 557 Introduction to Seismology**

Credits 3.00

Theory of propagation of seismic waves in elastic media. Solution of wave equations for compressional, shear and surface waves. Analysis of travel-times, amplitudes and attenuation of seismic waves in terms of ray and wave theory. Principles of the seismograph. Structure of the earth as determined by seismological studies. Investigation of the causes, effects, distribution and characteristics of earthquakes.

Prerequisite: EAS 111, MA 262. Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **EAS 657 Geophysical Inverse Theory**

Credit. 3.00

Investigates problems of determining physical parameters of the earth from remote observations of wave and potential fields. The theoretical topics include spectral and singular value decompositions, maximum likelihood and stochastic inversion, Backus and Gilbert theory, Green's function and linear operators, and the physics of layered media. Geophysical applications include seismic tomography, deconvolution, gravity and magnetics, earthquake sources, geodetics, and remote sensing.

### **ECE 301 - Signals and Systems**

Credits: 3.00

Classification, analysis and design of systems in both the time- and frequency-domains. Continuous-time linear systems: Fourier Series, Fourier Transform, bilateral Laplace Transform. Discrete-time linear systems: difference equations, Discrete-Time Fourier Transform, bilateral Z-Transform. Sampling, quantization, and discrete-time processing of continuous-time signals. Discrete-time nonlinear systems: median-type filters, threshold decomposition. System design examples such as the compact disc player and AM radio.

Prerequisite: [ECE 202](#). Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **ECE 438 - Digital Signal Processing with Applications**

Credits: 4.00

The course is presented in five units. Foundations: the review of continuous-time and discrete-time signals and spectral analysis; design of finite impulse response and infinite impulse response digital filters; processing of random signals. Speech processing; vocal tract models and characteristics of the speech waveform; short-time spectral analysis and synthesis; linear predictive coding. Image processing: two-dimensional signals, systems and spectral analysis; image enhancement; image coding; and image reconstruction. The laboratory experiments are closely coordinated with each unit. Throughout the course, the integration of digital signal processing concepts in a design environment is emphasized.

Prerequisite: [ECE 301](#), [302](#). Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **ECE 495Y - Sound Reinforcement System Design**

Credits: 3.00

Mobile communications technologies and applications: interaction between different wireless protocols; mobile access, viewing, control, and printing of multimedia documents, databases, and video; security in mobile environments; mobile e-services. Students will work in teams to design and prototype new solutions that exploit mobile technologies to transform the way people communicate and process information. During the weekly lecture, students will learn the fundamentals of wireless technologies, the relevant application areas, and the design process. The weekly schedule lab period will facilitate project coordination and planning.

Department approval is required.

### **ECE 511 / PSY 511 - Psychophysics**

Credits: 3.00

An examination of the relationship between physical stimuli and perception (visual, auditory, haptics, etc.). Includes a review of various methods for studying this relationship and of the mathematical and computational tools used in modeling perceptual mechanisms.

Instructor approval is required.

### **ECE 526 / BME 581 - Fundamentals of MEMS and Micro-Integrated Systems**

Credits: 3.00

Key topics in micro-electro-mechanical systems (MEMS) and biological micro-integrated systems; properties of materials for MEMS; microelectronic process modules for design and fabrication. Students will prepare a project report on the design of a biomedical MEMS-based micro-integrated system. Offered in alternate years.

Instructor approval is required.

### **ECE 528 / BME 528 - Measurement and Stimulation of the Nervous System**

Credits: 3.00

Engineering principles addressing questions of clinical significance in the nervous system: neuroanatomy, fundamental properties of excitable tissues, hearing, vision, motor function, electrical and magnetic stimulation, functional neuroimaging, disorders of the nervous system, development and refinement of sensory prostheses.

Prerequisite: ECE 301, 302. Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **ECE 538 - Digital Signal Processing I**

Credits: 3.00

Theory and algorithms for processing of deterministic and stochastic signals. Topics include discrete signals, systems, and transforms, linear filtering, fast Fourier transform, nonlinear filtering, spectrum estimation, linear prediction, adaptive filtering, and array signal processing.

Prerequisite: [ECE 301](#), [302](#). Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **ECE 544 - Digital Communications**

Credits: 3.00

Introduction to digital communication systems and spread spectrum communications. Topics include analog message digitization, signal space representation of digital signals, binary and M-ary signaling methods, detection of binary and M-ary signals, comparison of digital communication systems in terms of signal energy and signal bandwidth requirements. The principal types of spread spectrum systems are analyzed and compared. Application of spread spectrum to multiple access systems and to secure communication systems is discussed.

Prerequisite: [ECE 440](#); or Masters Student Standing or higher. Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **ECET 304 - Introduction to Communication Systems**

Credits: 4.00

The theory and techniques of sending information (voice, music, data, etc.) from one location to another is studied. This includes signal analysis, AM, FM, and PM, modulation techniques, transmitters, receivers, networks, filters, and antennas through the VHF frequency spectrum. In addition, transmission lines, wireless communication, digital communication, and special topics of current interest are introduced. This course also incorporates a student-based communication system design laboratory.

Prerequisite: [ECET 257](#), [MA 222](#). Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

One year each of anatomy/physiology and calculus, and one semester of organic chemistry. Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **ECET 374 - Digital Telecommunications**

Credits: 4.00

This is an advanced course in digital communications concepts and applications. Digitalization of analog signals, modulation of digital signals, signaling techniques, multiplexing and protocols are investigated. Applications of transport technologies utilizing underlying digital communication protocols are discussed. Transfer of digital information through diverse communication media is emphasized. Practical application of the technologies and protocols are investigated in the laboratory.

Prerequisite: [CPT 230](#)([C&IT 230](#) effective Summer 2006), [ECET 233](#), [MA 222](#), [PHYS 219](#), [STAT 225](#). Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **I E 558 - Safety Engineering**

Credits: 3.00

Application of human factors and engineering practice in accident prevention and the reduction of health hazards are presented. The objective of this course is to provide an understanding of the safety and health practices which fall within the responsibilities of the engineer in industry. Special attention is devoted to the detection and correction of hazards and to contemporary laws and enforcement on occupational safety and health.

Prerequisite: [I E 386](#). Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **M E 413 - Noise Control**

Credits: 3.00

Fundamentals of acoustic waves. Psychoacoustics and theories of hearing. Environmental and building acoustics. Measurement methods and common instrumentation. Noise control methods. Machinery noise. Community reaction. Legal aspects. Design-oriented semester project.

Course work in Physics, General; Course work in differential equations. Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **M E 513 - Engineering Acoustics**

Credits: 3.00

The simple oscillator. Lumped acoustical elements. Electro-mechanical-acoustical analogies. Wave motion in strings and membranes. Introduction to linear acoustics through derivation of the wave equation and simple solutions. Plane and spherical waves. Acoustic intensity. Plane wave transmission through fluid layers and simple barriers. Sound absorption. Modeling of acoustical sources: monopoles, dipoles, quadrupoles. Mechanisms of sound generation and directionality. Sound propagation in one-dimensional systems (e.g., ducts and mufflers). Introduction to room acoustics.

First Semester Senior Standing or higher. Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **M E 563 - Mechanical Vibrations**

Credits: 3.00

Review of systems with one degree for freedom. La Grange's equations of motion for multiple degree of freedom systems. Introduction to matrix methods. Transfer functions for harmonic response, impulse response, and step response. Convolution integrals for response to arbitrary inputs. Principle frequencies and modes. Applications to critical speeds, measuring instruments, isolation, torsional systems. Introduction to nonlinear problems.

Prerequisite: C E 273, M E 365. Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **M E 564 - Vibrations of Discretized Systems**

Credits: 3.00

Theory of small oscillations of discrete or discretized systems of high dimensionality. Formulation of equations of motion using Lagrange's equation and the influence coefficients. Finite element reductions of continuous systems. Natural frequencies and modes: numerical methods. Free vibrations and forced vibration characteristics; modal expansion; approximation techniques; damping. Assembly of large systems from subsystems concepts, impedance techniques. ME613-Advanced Engineering Acoustics An extension of M E 513. Sound transmission between two media. Acoustic resonators and application to muffler theory. Structural radiation and sound. Acoustical measurements and signal processing: sound intensity, surface intensity, coherence and cepstral techniques. Numerical acoustics: finite element analysis, boundary integral equation analysis and statistical energy analysis. Advanced topics

Prerequisite: M E 563. Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **M E 579 - Fourier Methods in Digital Signal Processing**

Credits: 3.00

Fundamentals of signal processing associated with Fourier analyzer systems are presented. Emphasis is on amplitude accuracy and frequency resolution properties necessary for reliable experimental methodologies in system identification, spectrum estimation, and correlation analysis. Deterministic, as well as random, data analyses are presented. Students are required to develop algorithms that significantly expand the utility of Fourier analyzer systems.

Prerequisite: [M E 475](#). Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **M E 615 / A&AE 615 - Aeroacoustics**

Credits: 3.00

Quantitative measures of sound (decibel scales, spectra, energetics of acoustic motions, and measurement techniques). The wave theory of sound (basic equations and properties, sound propagation in homogeneous and inhomogeneous media, one-, two- and three-dimensional sound fields and distributed sources). Effects of source movement. Aerodynamic noise generation - acoustic analogy (Lighthill's equation and fowcs Williams-Hawkings equation). Introduction to Computational Aeroacoustics (CAA). Noise from turbulent shear flows (jet noise, cavity noise, and noise from flow over objects). Noise from turbomachinery, propellers, and rotors.

Prerequisite: [A&AE 511](#) or [M E 509](#) or [513](#). Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **M E 664 - Vibrations of Continuous Systems**

Credits: 3.00

Theory of small oscillations of continuous systems. Love's equations for thin shells, reduction to special cases of shallow shells, plates, beams, etc. Initial stresses; influence of shear; thermal

excitation. Initial value problems; forced vibrations; structural damping. The dynamic Green's function, impedance concepts; variational approaches. Experimental procedures, scaling, composite, and stiffened shells.

Prerequisite: knowledge of one degree of freedom system vibrations. Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **NUCL 553 - Nano-to-Macro Scale Engineering Applications of Nuclear Technology**

Credits: 3.00

Acoustics of bubbles; Sound assisted implosion and supercompression leading to thermonuclear fusion events; Acoustics for detection of contraband/special nuclear material emissions.

Prerequisites: First Semester Senior Standing or higher or Masters Student Standing or higher, enrolled in Science, Engineering, or Technology. Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **OLS 331 - Occupational Safety and Health**

Credits: 3.00

A presentation of the aspects of occupational safety and health that are essential to the organizational leaders. Special emphasis is placed on developing an understanding of the economic, legal, and social factors related to providing a safe and healthy work environment.

Prerequisite: [OLS 252](#). Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **PSY 310 - Sensory and Perceptual Processes**

Credits: 3.00

A survey of the study of psychological experiences caused by stimulation to the senses. Topics include theory and research in seeing, hearing, touching, smelling, and tasting as experienced by humans and other animals.

### **PSY 511 - Psychophysics**

see ECE 511

### **PSY 512 – Neural Systems**

see BIOL 562

### **SLHS 302 - Acoustic Bases of Speech And Hearing**

Credits: 3.00

The physical characteristics of speech sounds and the psychophysical processes involved in hearing.

Corequisite: [SLHS 306](#). Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **SLHS 304 - Anatomy and Physiology of Hearing**

Credits: 3.00

An introduction to the anatomical and physiological bases of normal and abnormal voice, articulation, and hearing. Laboratory includes demonstrations to support lecture material.

### **SLHS 501 - Neural Bases of Hearing**

Credits: 3.00

Study of normal human neuroanatomy and neurophysiology related to speech, language, and hearing functions. Includes material concerning normal and abnormal neurological development over the lifespan.

Prerequisite: [SLHS 304](#). Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **SLHS 502 - Fundamentals of Speech Production and Perception**

Credit: 3.00

The physical, biological, and behavioral correlates of normal speech production and perception. The laboratory experience includes an exposure to the measures and methods of speech science.

### **SLHS 503 - Auditory Perception**

Credits: 3.00

Behavioral measurement of the capabilities of the normal and impaired auditory system. The laboratory experience includes an exposure to the measures and methods of hearing science.

Corequisite: [SLHS 504](#), [506](#). Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **SLHS 504 - The Auditory Periphery**

Credits: 2.00

Anatomy and physiology of the auditory system through the level of the cochlea. Concentrates on cochlear processing, including nonlinear responses, active feedback mechanisms, and the effects of damage.

### **SLHS 509 - Language Acquisition**

Credits: 3.00

An examination of research and theory dealing with first language acquisition in children. A linguistic framework is used to describe developing language. Topics considered include speech perception, grammatical development, meaning, and language in nonmodal populations.

### **SLHS 519M - Hearing Aids Seminar II**

Credits: 3.00

Study of special topics, drawn from areas not covered in permanent courses. Topics may vary from semester to semester.

### **SLHS 532 - Voice Disorders**

Credits: 3.00

Principles of differential diagnosis and clinical management for children and adults presenting voice disorders, based on a working knowledge of normal laryngeal structure and function.

Prerequisite: [SLHS 430](#). Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **SLHS 537 - Developmental Motor Speech and Feeding Disorders**

Credits: 3.00

Normal aspects of speech motor and feeding development are studied. Theories derived from normal processes are applied to designing assessment and intervention approaches for infants and children with a range of clinical diagnoses (e.g., cleft palate, tracheostomy, or Down Syndrome).

Prerequisite: [SLHS 521](#). Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **SLHS 538 - Motor Disorders of Speech**

Credits: 2.00

A study of the neuropathologies that affect the speech production system. Emphasizes the differential diagnosis and management of acquired motor speech disorders.

Prerequisite: [SLHS 501](#), [502](#). Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **SLHS 553 - Cochlear Implants**

Credits: 3.00

Provides fundamental principles to assist audiologists and speech-language pathologists in the understanding of candidacy, principles of signal processing, and audiologic rehabilitation for children and adults who use cochlear implants.

Prerequisite: [SLHS 503](#). Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **SLHS 564 - Hearing Aids I**

Credits: 3.00

An examination of amplification systems as applied in audiological rehabilitation; acoustic, electroacoustic, electronic, and clinical considerations. Laboratory exercises in measurement, modifications, maintenance, selection, and dispensing of hearing aid systems.

Prerequisite: [SLHS 460](#). Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **SLHS 570 - Noise and Man**

Credits: 3.00

A study of noise as a health hazard and as a nuisance; an examination of the ways in which hearing problems related to noise may be reduced.

### **SLHS 606 - Experimental Phonetics**

Credits: 3.00

Review and critical study of current experimental literature in acoustics and perception of speech. Offered in alternate years.

### **SLHS 658 - Advanced Topics In Audiology**

Credits: 2.00

Detailed study of selected topics in audiology.

### **THTR 163 - Introduction to Sound Design and Technology**

Credits: 2.00

Introduction to theatre sound design and technology for general theatre students. Involvement in Division of Theatre production program.

### **THTR 263 - Introduction to Sound Studios**

Credits: 3.00

An introduction to theories and techniques of audio production, with special emphasis on theatre productions.

Prerequisite: Majors have priority. Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **THTR 353 - Theater Audio Techniques I**

Credits: 3.00

Offered 2002-2003 and alternate years. A theoretical and practical study of the technical aspects of audio as they relate to theatre. The course will include specifications, layout and installation techniques, operation, and maintenance of theatre sound systems, etc.

Prerequisite: [ECET 214](#); Majors have priority. Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **THTR 563 - Advanced Sound Design**

Credits: 3.00

Advanced study of the principles of sound design for theatre and theory application to specific problems. Offered in alternate years.

Prerequisite: THTR 363. Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

### **THTR 568A - Dance Sound Design**

Credits: 3.00

A described tutorial in theatrical design or design research.

### **THTR 568S - Special Problems In Audio Production**

Credits: 3.00

A described tutorial in theatrical design or design research.