

**378. Contemporary Astronomical Concepts**  
Winter of odd-numbered years. 3(3-0)  
217, MTH 113. Not open to astrophysics majors for credit.

Interstellar matter and star formation. Deaths of stars: supernovae, white dwarfs, neutron stars, pulsars. Radio astronomy; quasars; X-ray sources. Galaxies, clusters of galaxies, the expanding universe and cosmology.

**381. Astronomy for Teachers**  
Summer. 3(3-0) Summer Institute participant.

Selected topics in descriptive astronomy of special importance in teaching. Methods of distance determination. Important properties of stars, our galaxy, and the universe.

**437. Observatory Practice**  
Fall. 3(1-4) 217 and MTH 113.

Stellar photography. Photographic photometry. Photoelectric photometry and corrections for atmospheric extinction. Multicolor photometric systems. Astronomical spectroscopy and radial velocity determinations.

**458. Astrophysics**  
Winter. 3(3-0) PHY 289 or approval of department.

Properties of a gas under conditions of astrophysical interest. Atomic spectroscopy. Emission and absorption of radiation. Physical properties of stellar atmospheres and other astronomical objects as inferred from the spectra.

**459. Solar System Physics**  
Spring. 3(3-0) PHY 289 or approval of department.

Physical properties of the sun, interplanetary space, planets, and satellites as deduced from terrestrial observations and from space probes. Recent results of the NASA space program will be emphasized.

**490. Special Problems**  
Fall, Winter, Spring, Summer. 1 to 5 credits. Approval of department.

Individual study or project under the direction of a faculty member. An oral report on the work may be required in department seminar.

**819. Stellar Structure**  
Spring of even-numbered years. 3(3-0)  
458 or PHY 395 or approval of department.

Physical properties of the stellar interior. Methods of calculating models. Stellar evolution. Comparison of theory with current observations.

**828. Galactic Structure**  
Winter of even-numbered years. 3(3-0)  
PHY 427 or approval of department.

Distribution and dynamics of stars and interstellar material in our galaxy. Spiral structure. Galactic evolution.

**839. Celestial Mechanics**  
Spring of even-numbered years. 3(3-0)  
PHY 427 or approval of department.

Two-body, three-body, and n-body problems. Orbital elements. Potential of solid objects. Orbital motion and perturbations for planets, rockets, and satellites.

**850. Ionized Gases**  
Spring. 3(3-0) E E 835 or PHY 448. Interdepartmental with and administered by Electrical Engineering.

Elastic collision processes; Boltzmann equation; moment equations; basic plasma phenomena; motion of a charged particle in electrical and magnetic field; individual and collective charged particle behavior.

**859. Stellar Atmospheres**  
Spring. 3(3-0) 458 or PHY 395 or approval of department.

The physics of radiation and the equation of its

transfer. Theory of absorption coefficient and line absorption profile. The gray atmosphere and calculation of model atmospheres.

**860. General Relativity and Cosmology**  
Fall of even-numbered years. 3(3-0)  
PHY 859 or approval of department. Interdepartmental with and administered by the Physics Department.

The relativistic gravitational field equations will be developed and experimental evidence for their validity will be discussed; various relativistic cosmological models and their relation to astronomical evidence will be presented.

**989. Waves and Radiations in Plasmas**  
Fall of even-numbered years. 3(3-0)  
E E 850. Interdepartmental with and administered by Electrical Engineering.

Plasma oscillation; interaction, electromagnetic fields with plasmas, wave propagation in magnetoionic media; plasma sheath; radiation of electric source in incompressible and compressive plasmas; electroacoustic waves; magneto-hydrodynamics; research topics in plasmas.

## AUDIOLOGY AND SPEECH SCIENCES ASC

### College of Communication Arts

**093. Remedial Speech**  
Fall, Winter, Spring, Summer. 0(2-0)  
[2(2-0)]†.

Special help in relieving or compensating for disorders of speech.

**108. Voice and Articulation**  
Fall, Winter, Spring, Summer. 3(4-0)

The study and development of the skills of voice and articulation.

**222. Oral Language Development**  
Winter, Summer. 3(2-0)

Emergence and development of receptive and expressive aspects of oral language of the child.

**276. Descriptive Phonetics**  
(275.) Fall, Spring. 3(3-0)

Detailed description of the principles that underlie the production of speech sounds.

**277. Scientific Bases of Voice Communication Process**  
(275.) Winter, Spring. 3(3-0)

Scientific bases of voice communication with special reference to the acoustic aspect of production.

**372. Speech Pathology I**  
Fall, Winter. 5(3-0) 276, 277.

Etiology, symptomatology, and rationale of therapy for speech and language problems.

**373. Clinical Procedures in Speech Pathology and Audiology**  
Winter, Spring, Summer. 4(2-2)

Principles underlying the clinical interview and client relationships essential to diagnosis and therapy. Procedures in obtaining, recording, and evaluating test results and therapeutic methods.

**444. Oral Language of Urban Areas**  
Spring, Summer. 3(3-0)

Concentration in the characteristics of language and human communication as these relate to studies and practices of those involved in urban affairs.

**454. Audiology I**  
Fall, Winter, Spring, Summer. 5(4-1)  
276, 277.

Fundamental aspects of hearing; nature, testing and rehabilitation.

**460. Audiology II**  
Winter, Spring. 5(3-0) 454 or approval of department.

Theory and methodology in the teaching of lip-reading and auditory training to the acoustically handicapped.

**470. Speech Correction for Teachers**  
Fall, Winter, Spring, Summer. 3(3-0)  
Juniors. Not open to speech pathology and audiology majors.

Meeting needs of the speech handicapped child in classroom.

**473. Speech Pathology II: Diagnostics**  
Fall, Winter, Spring, Summer. 5(3-2)  
372, 373 and 2 credits of 474 or approval of department.

Test procedures and analysis; supervised clinical experience in language and speech evaluations and report writing.

**474. Clinical Practice in Speech Correction**  
Fall, Winter, Spring, Summer. 1 to 3

credits. May re-enroll for credit. Six credits required for certification. No more than 2 credits may be taken during the preprofessional program. 372.

**475. Structures and Functions of Speech and Hearing Mechanisms**  
(854A.) Fall. 3(3-0) Approval of department.

Peripheral and central auditory mechanisms and the respiratory, phonatory and articulatory mechanisms for speech.

**477. Methods in Public School Speech and Hearing Therapy**  
Fall, Winter, Spring. 4(3-4) 372.

Must be taken prior to term of student teaching. Administration and organization, procedures and materials in public school speech and hearing therapy.

**499. Independent Study**  
Fall, Winter, Spring, Summer. 1 to 6  
credits. May re-enroll for a maximum of 12  
credits. Approval of department.

**831. Speech and Hearing Problems of Adults**

A. NEUROPATHOLOGIES OF SPEECH  
Winter. 4(3-0)

Neuropathology, symptomatology, and speech and language rehabilitation of adults.

B. VOICE DISORDERS  
Spring. 4(3-0)

Etiology, symptomatology, and therapeutic procedures for disorders of voice. Speech pathologist and audiologist in relation to other disciplines in the rehabilitation of adults with voice disorders.

**832. Speech and Hearing Evaluation and Therapy**

A. HEARING LOSS  
Summer. 4(2-0)

Review, evaluation, and development of techniques employed in lipreading training, auditory training, hearing aid orientation, and counseling for the acoustically handicapped.

B. CEREBRAL PALSY  
Spring. 4(3-0)

Etiology, symptomatology, structural and func-

tional consideration of cerebral palsy. Therapeutic procedures for the speech of the cerebral palsied.

**C. DELAYED LANGUAGE DEVELOPMENT**

Winter. 4(3-0)

Evaluative techniques including audiometry, psychometry, and case history as aids to the differential evaluation of delayed language development.

**D. MENTAL RETARDATION**

Winter. 4(3-0)

Language behavior and speech development of the mentally retarded as related to all facets of personal-social development and adjustment.

**E. STUTTERING**

Summer. 4(3-0)

Longitudinal studies of stuttering theories and the therapies accompanying them.

**F. CLEFT PALATE**

Fall. 4(2-0)

Etiology, symptomatology, structural and functional consideration of cleft palate. Therapeutic procedures for the speech habilitation of cleft palate individuals.

**833. Specialized Clinical Audiology**

**A. DIFFERENTIAL AUDIOMETRY**

Winter. 4(3-0)

Pure tone audiometric tests as an aid to the otologist in evaluating the pathology of hearing loss; including the development of norms. Consideration of nonorganic loss.

**B. SPEECH AUDIOMETRY AND EVALUATION OF HEARING AIDS**

Fall. 4(4-0)

Speech audiometry; principles and methods in the selection of hearing aids; physical characteristics of hearing aids.

**C. INDUSTRIAL AUDIOLOGY**

Summer. 4(2-2)

Evaluation of the role of the audiologist in industry emphasizing identification procedures, damage-risk criteria, measurement and control of noise, conservation procedures, and medico-legal problems.

**D. ADVANCED AUDIOLOGICAL EVALUATION**

Spring. 4(3-1)

Theory, administration and evaluation of selected tests including Bekesy, EDR, EEG, and advanced speech-audiometric tests.

**E. PEDIATRIC AUDIOLOGY**

Spring. 4(2-2)

Evaluative procedures including play audiometry, language assessment, and case studies as aids to the differential diagnosis of auditory disorders in children; habilitative procedures for the acoustically handicapped child.

**854. Psychophysics and Theories of Audition**

(854B.) Spring. 4(3-0)

Nature of auditory stimuli and the results of psychophysical experimentation in audition.

**874. Speech and Hearing Problems in Public Schools**

Summer. 4(3-0) May re-enroll for a maximum of 16 credits.

Graduate seminar in speech and hearing involving problems that arise in relation to speech and hearing therapy in the public schools.

**880A. Algorithms for Speech and Hearing Sciences**

Fall. 4(4-0)

A discussion of useful algorithms applicable to quantification of phenomena related to audiology and speech sciences.

**880B. Acoustic Phonetics**

(875C.) Winter. 4(2-2) 880A or approval of department.

An analytic study of the acoustics of speech.

**880C. Instruments and Electronics for Audiology and Speech Sciences**

(875A.) Spring. 4(3-3) 880B or approval of department.

A discussion of the electronic principles and instruments necessary to measure parameters related to hearing and speech processes.

**880D. Experimental Phonetics**

(875B.) Summer. 4(2-0) 880C or approval of department.

Critical review of the literature in experimental phonetics with special reference to the historical development of the field and subsequent experimentation in physiological and acoustical phonetics.

**899. Research**

Fall, Winter, Spring, Summer. Variable credit. Approval of department.

**940. Seminar in Audiology and Speech Sciences**

Spring, Summer. 4(2-0) May re-enroll for maximum of 16 credits.

**990. Special Problems in Audiology and Speech Sciences**

Fall, Winter, Spring, Summer. 1 to 6 credits.

Special projects in audiology and speech sciences.

**999. Research**

Fall, Winter, Spring, Summer. Variable credit. Approval of department.

**BIOCHEMISTRY**

**BCH**

**College of Agriculture and Natural Resources**

**College of Human Medicine**

**College of Natural Science**

**College of Osteopathic Medicine**

**163. Biochemistry Laboratory**

Spring. 2(0-6) Honors section of CEM 162, and approval of department.

Experimental aspects of biochemistry for biochemistry majors with an honors chemistry background.

**200. Introduction to Biochemistry**

Winter, Summer. 5(5-0) Credit may not be earned in both 200 and 401. General chemistry; one term organic chemistry. Not acceptable for a B.S. degree in biochemistry. Survey of biochemistry emphasizing the major metabolic activities of living organisms.

**363. Clinical Biochemistry**

Spring. 3(2-3) 200; CEM 162. Primarily for Medical Technology majors; not acceptable for a B.S. degree in biochemistry.

Quantitative clinical laboratory methods.

**400H. Honors Work**

Fall, Winter, Spring. Variable credit. Approval of department.

Assigned reading and experimentation.

**401. Basic Biochemistry**

Fall, Spring. 5(5-0) Credit may not be earned in both 200 and 401. One year organic chemistry or CEM 242; not open to biochemistry majors.

A one-term presentation of biochemistry emphasizing structure and function of major biomolecules, metabolism and regulation. Examples used for illustrative purposes will emphasize the mammalian organism.

**404. General Biochemistry Laboratory**

Fall, Winter, Spring. 3(1-6) Analytical chemistry; 401 or 451.

Experimental aspects of biochemistry.

**451. Biochemistry**

Fall, Winter. 4(4-0) Credit may not be earned in both 401 and 451. One year organic chemistry or CEM 242.

A comprehensive presentation of biochemistry designed for undergraduate biochemistry majors, students of medicine, and other students desiring an intensive treatment of the subject. In the winter term, students in the College of Human Medicine are given enrollment priority and the course emphasizes examples from the mammalian organism in contrast to the more cellular approach used in the fall term.

**452. Biochemistry**

Winter, Spring. 4(4-0) 451.

Continuation of 451. In the spring term, students in the College of Human Medicine are given enrollment priority and the course emphasizes examples from the mammalian organism in contrast to the more cellular approach used in the winter term.

**478. Senior Seminar**

Fall, Winter, Spring. 0 or 1(1-0). May re-enroll for a maximum of 2 credits. Undergraduate biochemistry major or approval of department.

Discussion, by undergraduate students and staff, of recent advances in biochemistry.

**499. Research**

Fall, Winter, Spring, Summer. 1 to 4 credits. May re-enroll for a maximum of 12 credits. Approval of department.

A course designed to give qualified undergraduate students an opportunity to gain experience in biochemical research.

**801. Biochemical Research Methods**

Fall. 1(0-3) One year of organic chemistry or CEM 242; 451 or 811, or concurrently. Discussions and demonstrations of selected experimental techniques of wide application in biochemistry.

**804. Advanced Biochemistry Laboratory**

Fall. 3(1-6) Analytical chemistry; 801 and 811, or concurrently; biochemistry majors or approval of department.

Experiments to be selected from a representative group illustrating modern biochemical research.

**805. Advanced Biochemistry Laboratory**

Winter. 3(1-6) 804; 812 concurrently.

Experiments to be selected from a representative group illustrating modern biochemical research.

**806. Advanced Biochemistry Laboratory**

Spring. 3(1-6) 805; 813 concurrently.

Special experiments in advanced laboratory techniques.

**811. Advanced Biochemistry**

Fall. 4(4-0) One year of organic chemistry, one year of physical chemistry, one term of introductory biochemistry, 801 taken previously or concurrently, or approval of department. Limited to graduate students in biochemistry or other students needing a similar professional preparation.

The structure and function of biomolecules, energy transformations and chemical reactions in living cells, regulation of cell reactions, and the replication of living organisms.

**812. Advanced Biochemistry**

Winter. 4(4-0) 811

Continuation of 811.