120. Topics in Astronomy
Winter, Spring. 4(4-0). AST 119.
Detailed qualitative discussion of currently interesting topics in astronomy. May include such topics as quasars, pulsars, black holes, planetary exploration, cosmology, concepts of relativity.

217. General Astronomy (N)
Fall, Winter, Spring. 4(4-0) MTH 102 or MTH 109 or MTH 111. Students may not receive credit in more than one of the following: AST 119, AST 217, AST 229.
Intended primarily for physical science majors. A semiquantitative presentation of current views of the universe including birth and death of stars, cosmology, comparisons of planets, and life in the universe.

229. General Astronomy
Fall. 4(4-0) PHY 287 or PHY 291H or concurrently MTH 113. Students may not receive credit in more than one of the following: AST 119, AST 217, AST 229.
Fundamental observations in astronomy and their interpretation through physical laws. Intended for physical science majors and recommended for astrophysics majors. Quantitative discussion of orbital motion, time, telescopes, solar system, stars, galaxies, and cosmology. Limited opportunity for astronomical observations.

327. Practical Astronomy
Winter. 3(3-0) AST 217 or AST 229.

378. Contemporary Astronomy
Winter. 3(3-0) AST 217 or AST 229.
A continuation of General Astronomy with particular emphasis on modern developments. May include such topics as planetary exploration, interstellar matter, star formation, stellar evolution through final stages, supernovae, pulsars, neutron stars, black holes, galaxies, and cosmology.

437. Observatory Practice
Spring. 3(1-4) AST 327 and approval of department.

458. Astrophysics
Winter. 3(3-0) AST 217 or AST 229, PHY 289, PHY 365 or approval of department.
Application of physical principles to the atmospheres and interiors of stars to deduce their physical properties. Discussion of radiation, spectra and gas properties.

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 3 credits. May reenroll for a maximum of 10 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.

800. Research Methods
Fall, Winter, Spring, Summer. 2(0-6)
May reenroll for a maximum of 6 credits. Beginning graduate students. Interdepartmental with and administered by the Department of Physics. Problems and techniques of current research by taking part in the design and setup of experiments, data taking and reduction; study and practice of theoretical methods. Areas of study; solid state and molecular science, nuclear, elementary particles, astronomy, astrophysics.

801. Seminar
Winter. 1(1-0) May reenroll for a maximum of 2 credits. Graduate students or approval of department.
Seminars to be presented by both faculty and students to review papers in the current astronomical research literature.

819. Stellar Structure
Spring. of even-numbered years. 3(3-0) AST 458 or PHY 395 or approval of department.
Spring. of odd-numbered years. 3(3-0) PHY 287 or PHY 291H or concurrently MTH 113. Students may not receive credit in more than one of the following: AST 119, AST 217, AST 229.

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.

850. Ionized Gases
Fall. 3(3-0) E E 835 or PHY 448; E E 850.
Ionized gasses. Elastic collision processes; Boltzmann equation; moment equations; motion of a charged particle in electrical and magnetic field; individual and collective charged particle behavior, macroscopic properties of plasmas, waves in the fluid plasma, transport phenomena in plasma.

859. Stellar Atmospheres
Spring. of odd-numbered years. 3(3-0) AST 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 I
Fall of even-numbered years. 3(3-0) PHY 858 or approval of department. Interdepartmental with and administered by the Department of Physics.
The conceptual foundations of general relativity theory; elements of tensor calculus; Riemann-Christoffel curvature tensor; the field equations; experimental tests; special solutions; the extension to cosmology.

861. General Relativity and Cosmology II
Winter of odd-numbered years. 3(3-0) PHY 860. Interdepartmental with and administered by the Department of Physics.
Relativistic cosmology: the model universe; steady-state theory; observational evidence and possibilities for decision among models; current problems.

984. Advanced Readings in Physics or Astronomy
Fall, Winter, Spring, Summer.
Variable credit. Interdepartmental with and administered by the Department of Physics.

989. Waves and Radiations in Plasmas
Fall of odd-numbered years. 2(3-0) E E 850.
Interdepartmental with the Department of Physics, and Electrical Engineering. Plasma oscillation; interaction, electromagnetic fields with plasmas, wave propagation in magnetic media; plasma sheet; radiation of electric source in incompressive and compressive plasmas; electroacoustic waves; magnetohydrodynamics; research topics in plasmas.

AUDIOLOGY AND SPEECH SCIENCES
ASC
College of Communication Arts and Sciences

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.

227. Physics for Audiology and Speech Sciences
Fall, Spring. 3(3-0) MTH 108. Not open to students with credit in PHY 237. Interdepartmental with and administered by the Department of Physics.
Introductory physics for Audiology and Speech Sciences majors: kinematics, Newton's Law, conservation of energy and momentum, waves and vibrations, sound propagation, resonance, speech production.

274. Structures and Functions of Speech and Hearing Mechanisms
Winter, Spring. 3(4-0) ASC 274 or approval of department.
Detailed description of the principles that underlie the production of speech sounds.

277. Scientific Bases of Voice Communication Process
Fall, Winter. 3(3-0) ASC 276 and PHY 237 or approval of department.
Scientific bases of voice communication with special reference to the acoustic aspect of production.
372. **Speech Pathology I**  
*Fall, Winter. 3(3-0) ASC 276, ASC 277.*  
Introduction to speech pathology. Theoretical and practical foundations of speech pathology as related to the normal and disordered speech process.  
*Prerequisites:* Prerequisite or approval of instructor.  
*Credits:* 3 credits.

373. **Clinical Procedures in Speech Pathology and Audiology**  
*Winter, Spring. 4(2-2) 2.00 grade-point average in ASC 277 and ASC 372 or approval of department.*  
Clinical procedures in the diagnosis and treatment of speech and language disorders.  
*Prerequisites:* ASC 276 and ASC 277 or approval of department.  
*Credits:* 4 credits.

444. **Oral Language of Urban Areas**  
*Winter, 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.*  
*Prerequisites:*  
*Credits:* 3 credits.

454. **Introduction to Audiology**  
*Fall, Spring. 3(4-1) ASC 276, ASC 277.*  
Fundamental aspects of normal hearing; hearing disorders, hearing tests.  
*Prerequisites:*  
*Credits:* 3 credits.

460. **Aural Rehabilitation**  
*Winter, Summer. 5(4-1) ASC 454 or approval of instructor.*  
Fundamental aspects of hearing aids, auditory training, and speechreading for the hearing-impaired person.  
*Prerequisites:*  
*Credits:* 5 credits.

470. **Communication Disorders**  
*Spring, Summer. 3(3-0) Junior, Not open to Audiology and Speech Sciences majors.*  
An overview of communication disorders; the professions of speech and language pathologist and audiologist and their relationships to allied professions.  
*Prerequisites:*  
*Credits:* 3 credits.

474. **Clinical Practicum in Speech and Language Pathology**  
*Fall, Winter, Spring. Summer. 1 credit. May reenroll for a maximum of 2 credits. Grade of 2.0 or better in both ASC 372 and ASC 373.*  
Therapeutic experience in speech and language pathologists.  
*Prerequisites:*  
*Credits:* 1 credit.

476. **Speech Pathology II: Diagnostics**  
*Fall, Winter, Spring, Summer. 3(3-2) ASC 474 or approval of department.*  
Tests procedures and analysis; supervised clinical experience in language and speech evaluations and report writing.  
*Prerequisites:*  
*Credits:* 3 credits.

477. **Methods in Public School Speech and Hearing Therapy**  
*Fall, Winter, Spring. 4(3-4) ASC 372. Must be taken prior to term of student teaching.*  
Administration and organization, procedures and materials in public school speech and hearing therapy.  
*Prerequisites:*  
*Credits:* 4 credits.

499. **Independent Study**  
*Fall, Winter, Spring. Summer 1 to 6 credits. May reenroll for a maximum of 12 credits. Approval of department.*  
*Credits:* 1 to 6 credits.

801. **Advanced Study of Articulatory Behavior**  
*Summer. 4(3-2) Approval of department.*  
Theoretical and pragmatic implications of the interrelationships of articulatory behavior and language production, especially as related to investigating procedures and results.  
*Prerequisites:*  
*Credits:* 4 credits.

810. **Audiologic Calibration Standards**  
*Summer. 4(1-2) ASC 854 or ASC 833A and ASC 853B; ASC 880A; approval of department.*  
Contemporary electro-acoustic and other measurement standards for audiometers, sound level meters, earphones, hearing aids, and related devices; current issues in standards development, laboratory in applied measurement.  
*Prerequisites:* ASC 853B, ASC 854, ASC 880A or approval of department.  
*Credits:* 4 credits.

811. **Speech and Hearing Problems of Adults**  
*A. Aphasia  
Winter. 4(4-0)  
Neuropsychology, symptomatology, and speech and language habilitation and rehabilitation of individuals with aphasia.  
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.*  
*Prerequisites:*  
*Credits:* 4 credits.

830. **Specialized Clinical Audiology**  
*A. Differential Audiology  
Fall. 4(3-0)  
Pure tone audiometric tests as an aid to the audiologist in evaluating the pathology of hearing loss; including the development of norms. Consideration of monaural 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  
Spring. 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.*  
*Prerequisites:*  
*Credits:* 4 credits.

832. **Speech and Hearing Evaluation and Therapy**  
*A. Hearing Handicap  
Summer. 4(2-2)  
A theoretical approach to the study of the aural rehabilitative process.  
B. Apraxia and Dysarthria  
Spring. 4(4-0)  
Neuropsychology, symptomatology, and speech and language habilitation and rehabilitation of individuals with apraxia and dysarthria, including those with cerebral palsy.*  
*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.*  
*Prerequisites:*  
*Credits:* 4 credits.

833. **Communication Sciences**  
*A. Neuroaudiology and Auditory Brainstem Evoked Responses  
Fall. 4(4-0)  
Electrophysiological and functional neurophysiological correlates of speech, language, and hearing.*  
*B. Psychoacoustics and Psychophysics  
Spring. 4(4-0)  
A critical survey of psychoacoustics and psychophysics as they pertain to the study of speech, language, and hearing.*  
*Prerequisites:*  
*Credits:* 4 credits.

834. **Communication Disorders: Neuropathology**  
*Fall, Winter, Spring. 4(2-2) Approval of department.*  
Clinical audiometry of the peripheral and central auditory system.  
*Prerequisites:*  
*Credits:* 4 credits.

835. **Acoustical Measurements**  
*Fall, Winter, Spring. 4(2-2) Approval of department.*  
An acoustical study of the characteristics of speech.  
*Prerequisites:*  
*Credits:* 4 credits.
880C. Instruments and Electronics for Audiology and Speech Sciences
Fall, Winter, Spring. 4(3-3) ASC 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
Fall, Winter, Spring. 4(4-0) ASC 880C or approval of department.
Critical review of the literature in experimental phonetics. Selected papers on acoustic and physiological phonetics and related fields are presented in seminar fashion.

899. Master's Thesis Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

900. Seminar in Audiology and Speech Sciences
Spring, Summer. 4(2-0) May reenroll for a maximum of 16 credits.

999. Doctoral Dissertation Research
Fall, Winter, Spring, Summer. 1 to 6 credits.
Special projects in audiology and speech sciences.

BIOCHEMISTRY

BCH
College of Agriculture and Natural Resources
College of Human Medicine
College of Natural Science
College of Osteopathic Medicine

200. Introduction to Biochemistry
Winter, Summer. 5(5-0) Credit may not be earned in both BCH 200 and BCH 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.

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 BCH 200 and BCH 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
Winter, Spring. 3(1-6) Analytical chemistry; BCH 401 or BCH 451. Experimental aspects of biochemistry.

405. Biochemistry Laboratory
Fall, Spring. 3(0-9) BCH 453 or concurrently. BCH 404; undergraduate biochemistry majors or approval of department. Advanced undergraduate laboratory to illustrate modern biochemical methods and techniques.

412. Clinical Biochemistry
1(6-3); Winter, Summer. 3(2-3) BCH 401; CEM 162. Medical Technology majors. Not acceptable for a B.S. degree in biochemistry. Others: approval of department. Quantitative clinical laboratory methods.

451. Biochemistry
Fall. 3(3-0) Credit may not be earned in both BCH 401 and BCH 451. One year organic chemistry or CEM 242. A comprehensive survey of biochemistry with emphasis on the properties and functions of biomolecules, energy-yielding and energy-requiring processes, and the transfer of genetic information.

452. Biochemistry
Winter. 3(3-0) BCH 451. Continuation of BCH 451.

453. Biochemistry
Spring. 3(3-0) BCH 452. Continuation of BCH 452.

499. Research
Fall, Winter, Spring, Summer. 1 to 4 credits. May reenroll 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.

501. Medical Biochemistry
Summer. 3(3-0) Open only to students in the professional programs in the College of Human Medicine and the College of Osteopathic Medicine. Basic biochemical principles and terminology of importance in medical biology.

502. Medical Biochemistry
Fall. 3(3-0) BCH 501 or approval of department. A continuation of BCH 501.

503. Cell Biology
Fall. 5(5-0). Admission to the College of Human Medicine. Interdepartmental with the departments of Microbiology and Public Health, Physiology, and Pharmacology and Toxicology. Administered by the Department of Microbiology and Public Health. Principles of cell biology for medical students.

504. Analytical Chemistry
Fall. 3(1-6) BCH 401 or BCH 451. Experimental aspects of biochemistry.

512. Medical Biochemistry II
Spring. 3(3-0) BCH 511. Basic biochemical principles and processes pertinent to specific areas of human pathophysiology.

801. Biochemical Mechanism and Structure I
Fall. 2(2-0) BCH 401, one year of organic chemistry and physical chemistry or concurrently; or approval of department. Structures, methods of structural analysis, synthesis, and reactions mechanisms of biological substances including protein, carbohydrates, lipids, porphyrins, phosphate esters, enzymes and coenzymes.

821. Biochemical Mechanism and Structure II
Winter, 2(2-0) BCH 821 or approval of department. Continuation of BCH 821.

831. Physiological Biochemistry
Winter. 3(3-0) BCH 401. Physiological biochemistry, with emphasis on metabolic interpretation of normal and altered physiological states of the human organism and appropriate animal models.

A-29