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 to teaching. Methods of distance determination. Important properties of stars, our galaxy, and the universe.

437. Observatory Practice
Fall. 3(4-4) 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 259 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 259 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.

460. 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.

481. 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.

482. 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.

483. 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.

485. Ionized Cases
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.

489. 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 850 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.

980. Waves and Radioactive 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 plasma, 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

College of Communication Arts

093. Remedial Speech
Fall, Winter, Spring, Summer. 0(2-0) (2-0-0). Special help in relieving or compensating for disorders of speech.

105. Voice and Articulation
Fall, Winter, Spring. 3(4-0) The study and development of the skills of voice and articulation.

222. Oral Language Development
Winter. 3(2-0) Emergence and development of receptive and expressive aspects of oral language of the child.

276. Descriptive Phonetics
(375.) Fall. Spring. 3(3-0) Detailed description of the principles that underlie the production of speech sounds.

277. Scientific Bases of Voice Communication Process
(375.) 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 initial 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 the 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 (354A)
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, neuropsychiatry, and speech and language rehabilitation of adults.

B. Voice Disorders
Spring. 4(3-0) Etology, 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
Spring. 4(2-0) Review, evaluation, and development of techniques employed in lipreading, auditory training, hearing aid orientation, and counseling for the acoustically handicapped.

B. Cerbral Faly
Spring. 4(3-0) Etology, symptomatology, structural and func-
Audiology Courses

A comprehensive study of the principles of auditory stimuli and the results of psychophysical experimentation in audition. Nature of auditory stimuli and the results of psychophysical experimentation in audition. 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 a 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

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.

290. Introduction to Biochemistry
Winter, Summer. 5(5-0) Credit may not be earned in both 290 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 290 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.

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