

ASTRONOMY AND ASTROPHYSICS

402*. Galaxies
 Spring. 3(3-0)
 P: AST 401, PHY 481.
 Contents and dynamics of the milky way. Mass and luminosity distributions of galaxies. Stellar populations. The interstellar medium. Evolution of galaxies. Active galactic nuclei.
 QP: PHY 427 PHY 447 QA: AST 462 AST 463

410*. Senior Thesis
 Fall, Spring. 1 to 4 credits. May reenroll for a maximum of 4 credits.
 R: Open only to seniors in Astrophysics.
 Design and execute an original experiment or computation. A written and oral report of the research is required.
 QA: AST 406

800*. Research Methods
 Fall, Spring, Summer. 3(3-0) May reenroll for a maximum of 6 credits.
 P: AST 801.
 Apprenticeship in astrophysical research; student will work closely with individual faculty member learning research techniques.
 QA: PHY 800

801*. Introduction to Astrophysics
 Fall. 3(3-0)
 Survey of contemporary astrophysics. Stellar evolution, the structure of the Milky Way, the properties of external galaxies, and cosmology.

810*. Radiation Astrophysics
 Spring of odd-numbered years. 3(3-0)
 P: AST 801.
 Transfer of radiation through plasmas and processes for emission and absorption of photons. Interpretation of the spectra of stars, interstellar medium, and galaxies.
 QA: AST 442

820*. Advanced Topics in Astrophysics(MTC)
 Fall, Spring. 3(3-0) May reenroll for a maximum of 9 credits.
 P: AST 801.
 Advanced work in a specialized astrophysical topic.
 QA: AST 820

820A*. Astrophysics of the Interstellar Medium
 3(3-0)
 P: AST 810, PHY 851.
 Relationships of the physical processes and radiative properties of diffuse interstellar material to observed characteristics.
 QP: PHY 837 QA: AST 820

830*. Galactic and Extragalactic Dynamics
 Fall of even-numbered years. 3(3-0)
 P: AST 801, PHY 820.
 Implications of gravitational dynamics and stellar evolution on galactic and extragalactic systems.

840*. Stellar Astrophysics
 Spring of even-numbered years. 3(3-0)
 P: AST 801.
 Physics of stellar interiors. Methods for calculating stellar models. Principles of stellar evolution.
 QA: AST 820

860*. Gravitational Astrophysics and Cosmology(MTC)
 Fall, Spring. 3(3-0) May reenroll for a maximum of 6 credits.
 Topics in general relativity, gravitational astrophysics, and cosmology.
 QA: PHY 860 PHY 861

860A*. Cosmology
 3(3-0)
 R: Open only to graduate students in Astronomy, Astrophysics and Physics.
 Current research in cosmology: observational basis for the Big Bang, the cosmic background radiation, primordial nucleosynthesis, content and distribution of matter, cosmic geometry, growth of perturbations.
 QA: PHY 861

860B*. Gravitational Astrophysics
 3(3-0)
 P: PHY 820, PHY 841.
 Experimental foundations, theory, and applications of gravitational physics and general relativity. Tests of the equivalence principle, modern solar system tests of general relativity, Schwarzschild metric, Hawking effect; Einstein's field equations
 QP: PHY 857 PHY 847 QA: PHY 860

870*. Astronomical Instrumentation and Data Analysis
 Fall of odd-numbered years. 3(3-0)
 P: AST 801.
 Theory and techniques of astronomical data acquisition and analysis.

AUDIOLOGY AND SPEECH SCIENCES ASC

113. Oral Communication Principles and Skills
 Fall, Spring, Summer. 3(2-2)
 Study, development and enhancement of oral communication skills including speech, voice, language and listening.
 QP: COM 115 QA: ASC 108

203. Introduction to Communication Sciences and Disorders
 Fall, Spring. 3(3-0)
 R: Not open to students with credit in ASC

403. Survey of research and practice regarding speech, hearing and language disorders in children and adults.
 QA: ASC 201

214. Anatomy and Physiology of the Speech and Hearing Mechanism
 Fall, Spring. 4(3-2)
 P: ASC 203 or concurrently.
 Structural and functional analyses of the central and peripheral auditory mechanisms, and of the respiratory, phonatory, and articulatory mechanisms for speech.
 QP: ASC 108 QA: ASC 274

232. Descriptive Phonetics
 Spring. 2(1-2)
 Principles of speech production. Transcription of speech using the International Phonetic Alphabet.
 QP: ASC 274 QA: ASC 276

255. Speech and Hearing Sciences
 Fall, Spring. 5(4-2)
 P: ASC 214, ASC 232 or concurrently, MTH 110 or MTH 116, one ISP course.
 R: Not open to freshmen.
 Application of the scientific method to the studies of audition, speech perception and speech production.
 QP: ASC 274 ASC 276 QA: ASC 277

333. Oral Language Development
 Fall. 3(3-0)
 P: ASC 203 or one LIN course or one PSY course. R: Not open to freshmen.
 Development of receptive and expressive aspects of child language.
 QA: ASC 222

344. Evaluation Procedures in Audiology
 Spring. 4(3-2)
 P: ASC 255. R: Open only to Audiology and Speech Sciences majors.
 Classification of hearing disorders. Behavioral and electrophysiological measurement of hearing, including subjective and objective testing procedures.
 QP: ASC 276 ASC 277 QA: ASC 454

364. Evaluation Procedures in Speech-Language Pathology
 Spring. 4(3-2)
 P: ASC 333. R: Open only to Audiology and Speech Sciences majors.
 Evaluation procedures in speech-language pathology, test procedures, evaluation of results, and report writing.
 QP: ASC 201 ASC 277 QA: ASC 373

403. Communication Sciences and Disorders
 Fall. 3(3-0)
 R: Not open to freshmen and sophomores.
 Not open to Audiology and Speech Sciences majors. Not open to students with credit in ASC 203.
 Research and practice regarding communication disorders and the professions of speech-language pathology and audiology.
 QP: ASC 201 QA: ASC 470

433. Language Dialect Differences in Applied Contexts
 Spring. 3(3-0)
 R: Not open to freshmen and sophomores.
 Regional, ethnic, and cultural characteristics of American English. Comparison of speech-language differences and disorders.
 QA: ASC 444

443. Aural Rehabilitation
 Fall. 3(3-0)
 P: ASC 344. R: Open only to Audiology and Speech Sciences majors.
 Fundamental aspects of auditory rehabilitation, including individual and group amplification systems, auditory training, speechreading, and counseling with children and adults.
 QP: ASC 454 QA: ASC 460

463. Intervention Procedures in Speech-Language Pathology
 Fall. 3(3-0)
 P: ASC 364. R: Open only to Audiology and Speech Sciences majors.
 Intervention procedures for individuals with developmental and acquired communication disorders.
 QP: ASC 373 QA: ASC 476

483. School-Based Communication Disorders Programs
 Spring. 3(3-0)
 P: ASC 463, ASC 494 or concurrently. R: Open only to Audiology and Speech Sciences majors.
 Administrative and regulatory aspects of school-based programs for persons with communication disorders.
 QP: ASC 201 ASC 373 QA: ASC 477

490. Independent Study
 Fall, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 8 credits.
 R: Open only to juniors and seniors.
 Approval of department, application required.
 Individualized student activities in human communication sciences and disorders.
 QA: ASC 499

494. Clinical Practicum in Communication Disorders
 Fall, Spring, Summer. 1(-) May reenroll for a maximum of 2 credits.
 P: ASC 463. R: Open only to Audiology and Speech Sciences majors.
 Supervised provision of clinical services to individuals with speech, language and/or hearing disorders.
 QP: ASC 201 ASC 373 QA: ASC 474

AUDIOLOGY AND SPEECH SCIENCES

- 803*.** **Research Methods in Communication Sciences and Disorders**
Fall. 3(3-0)
R: graduate students only audiology and speech science graduate students
Introduction to research methods in communication disorders including aspects of hypothesis generation, research design, data collection and analysis, research writing and evaluation.
QA: COM 405
- 813*.** **Neuroanatomy and Neurophysiology of Speech, Language, and Hearing**
Fall. 3(3-0)
R: class 6 audiology and speech sciences
Structural and functional descriptions of the nervous system as it relates to communication sciences and disorders.
QA: ASC 876
- 823A*.** **Acquired Language Disorders**
Spring. 3(3-0)
P: ASC 813 or concurrently R: class 6 audiology and speech sciences
Neuropathology, symptomatology, and speech-language habilitation and rehabilitation of individuals with apraxia and/or related disorders.
QP: ASC 876 QA: ASC 841A
- 823B*.** **Motor Speech Disorders**
Fall. 3(3-0)
P: ASC 813 or concurrently R: graduate students audiology and speech science majors
Neuropathology, symptomatology, and speech-language habilitation and rehabilitation of individuals with apraxia and/or dysarthria.
QP: ASC 876 QA: ASC 841B
- 823C*.** **Voice Disorders**
Spring. 3(3-0)
R: graduate students audiology and speech sciences
Etiology, symptomatology, development, diagnosis, and intervention procedures of voice disorders in children and adults.
QA: ASC 841C
- 823D*.** **Fluency Disorders**
Fall. 3(3-0)
R: graduate students audiology and speech sciences
History, theories, symptomatology, development, diagnosis, and intervention of fluency disorders in children and adults.
QA: ASC 841D
- 823E*.** **Assessment of Childhood Language Disorders**
Fall. 3(3-0)
R: graduate students audiology and speech science
Principles of assessment of language disorders in preschool, school-aged, and adolescent populations.
QA: ASC 841F
- 823F*.** **Language Intervention: Early Stages**
Spring. 3(3-0)
P: ASC 823E or approval R: graduate students audiology and speech sciences
Principles of language intervention for children with language disorders who are functioning at or below preschool levels.
QP: ASC 841F QA: ASC 841G
- 823G*.** **Language Intervention: Later Stages**
Summer. 3(3-0)
P: ASC 823 E or approval R: graduate audiology and speech sciences
Principles of language intervention for children with language disorders who are functioning above preschool levels. School-age children and adolescents.
QP: ASC 841F QA: ASC 841H
- 823H*.** **Augmentative Communication**
Spring. 3(3-0)
R: graduate students audiology and speech sciences
Historical perspective and philosophy of augmentative/alternative communication. Aided and unaided systems and approaches. Assessment, system selection, and intervention consideration.
QA: ASC 842
- 833*.** **Auditory Psychophysics**
Spring. 3(3-0)
P: ASC 803 or concurrently R: graduate students audiology and speech sciences
Psychophysical theory, methods and phenomena. Applications to the study of hearing.
QP: COM 405 QA: ASC 854
- 843A*.** **Hearing assessment**
Fall. 3(3-0)
R: graduate ASC
Clinical assessment and evaluation of hearing. Pure tone and speech audiometry and immittance testing.
QA: ASC 833A
- 843B*.** **Differential Diagnostic Audiology**
Spring. 3(3-0)
P: ASC 843A R: graduate ASC
Selected tests of peripheral and central auditory function.
QP: ASC 833A QA: ASC 833B
- 843C*.** **Hearing Amplification and Rehabilitation**
Spring. 3(3-0)
P: ASC 843A R: graduate students ASC
Historical and contemporary issues related to the clinical management of the hearing impaired with respect to amplification and other forms of aural rehabilitation.
QP: ASC 833A QA: ASC 833I ASC 833G
- 843D*.** **Electrophysiologic assessment**
Fall. 3(3-0)
P: ASC 813 or concurrently R: graduate students ASC
Theory, administration and evaluation of measurements of evoked potentials. Electrophysiologic tests of the auditory and vestibular systems.
QP: ASC 876 QA: ASC 833H ASC 833J
- 843E*.** **Special Populations in Audiology**
Summer. 3(3-0)
P: ASC 843A, ASC 843C R: graduate students audiology and speech sciences majors
Audiologic considerations and evaluative procedures for infant, pediatric, mentally impaired, multiply handicapped, and geriatric populations.
QP: ASC 833AASC 833GASC 833I QA: ASC 833E ASC 833F
- 843F*.** **Hearing Conservation**
Fall. 3(3-0)
P: ASC 833, ASC 843A, or approval R: graduate students ASC majors
The role of the audiologist in hearing conservation programs in occupational, educational, and community settings.
QP: ASC 854 ASC 833A QA: ASC 833C
- 890*.** **Independent Study**
Fall, Spring, Summer. 1 to 4 credits.
May reenroll for a maximum of 8 credits.
R: graduate ASC majors
Individualized faculty supervised activities for M.A. students in human communication sciences and disorders.
QA: ASC 990
- 894A*.** **Clinical Practicum in Speech-Language Pathology**
Fall, Spring, Summer. 1(1-0) May reenroll for a maximum of 6 credits.
R: graduate students ASC majors
Supervised clinical experience in management of clients with emphasis on speech-language disorders.
QA: ASC 875A
- 894B*.** **Clinical Practicum in Audiology**
Fall, Spring, Summer. 1(1-0) May reenroll for a maximum of 6 credits.
R: graduate students ASC
Supervised clinical experience in management of clients with emphasis on auditory disorders.
QA: ASC 875B
- 899*.** **Master's Thesis Research**
Fall, Spring, Summer. 1 to 4 credits.
May reenroll for a maximum of 6 credits.
R: graduate students ASC
Faculty supervised thesis research.
QA: ASC 899
- 914A*.** **Speech Production and Perception: I**
Fall of even-numbered years. 4(3-2)
P: ASC 803 or concurrently R: graduate students, class 6
Advanced classroom and laboratory study of issues regarding speech production and perception.
QP: COM 405
- 914B*.** **Speech Production and Perception: II**
Spring of odd-numbered years. 4(3-2)
P: ASC 914A R: graduate students ASC
Advanced classroom and laboratory study of issues regarding speech production and perception. A continuation of ASC 914A.
- 990*.** **Independent Study**
Fall, Spring, Summer. 1 to 4 credits.
May reenroll for a maximum of 16 credits.
R: class 7
Individualized faculty supervised activities for Ph.D. students in human communication sciences and disorders.
QA: ASC 990
- 991*.** **Special Topics in Communication Sciences and Disorders**
Fall, Spring, Summer. 3(3-0) May reenroll for a maximum of 12 credits.
R: graduate students ASC approval of department
Variable topics lecture course in human communication sciences and disorders.
- 992*.** **Seminar in Communication Sciences and Disorders**
Fall, Spring, Summer. 3(3-0) May reenroll for a maximum of 12 credits.
R: graduate level students ASC majors approval of department
Various topics seminar in human communication sciences and disorders.
QA: ASC 940
- 994*.** **Research Practicum in Communication Sciences and Disorders**
Fall, Spring, Summer. 1(1-0)
P: ASC 803 or concurrently R: graduate students
Research experiences under the direction of individual faculty.
QP: COM 405

AUDIOLOGY AND SPEECH SCIENCES

999*. **Doctoral Dissertation Research**
 Fall, Spring, Summer. 2 to 12 credits
 in increments of 2 credits. May
 reenroll for a maximum of 98 credits.
 R: graduate level ASC
 Faculty supervised dissertation research.
 QA: ASC 999

BIOCHEMISTRY BCH

100. **Current Issues in Biochemistry**
 Spring. 1(1 -0)
 R: Freshmen only.
 Contemporary biochemistry: its impact on environ-
 mental, medical, and social sciences.
 QA: BCH 100

200. **Introduction to Biochemistry**
 Fall. 4(4 -0)
 P: CEM 143. R: Not open to students with
 credit in BCH 401 or BCH 461.
 Basic structures of major classes of biologically impor-
 tant molecules and metabolic activities of major im-
 portance in living organisms.
 QP: CEM 143 QA: BCH 200

401. **Basic Biochemistry**
 Fall, Spring. 4(4 -0)
 P: CEM 252 or concurrently. R: Not open
 to students with majors in Biochemistry. Not open to
 students with credit in BCH 200 or BCH 461.
 Structure and function of major biomolecules, metabo-
 lism, and regulation. Examples emphasize the mam-
 malian organism.
 QP: CEM 242 ORCEM 353 QA: BCH 401

461. **Biochemistry I**
 Fall. 3(4 -0)
 P: CEM 252 or CEM 352, MTH 120 or
 MTH 124 or MTH 132, BS 110, BS 111. R: Not open
 to students with credit in BCH 200 or BCH 401.
 Protein structure and function, enzymology, bioener-
 getics, and intermediary metabolism.
 QP: CEM 242 ORCEM 353 QA: BCH 452

462. **Biochemistry II**
 Spring. 3(4 -0)
 P: BCH 461.
 Continuation of BCH 461 with emphasis on metabolic
 regulation and nucleic acid structure, replication and
 protein synthesis.
 QP: BCH 451 ANDBCH 452 QA: BCH 453

471. **Biochemistry Laboratory**
 Spring. 2(0 -6)
 P: CEM 262, BCH 461. R: Biochemistry
 majors or approval of department.
 Modern biochemical techniques used in the study of
 enzymes (proteins), lipids, and cell organelles.
 QP: BCH 451 ORBCH 401MTH 113 QA: BCH
 404

472. **Biochemistry Laboratory**
 Fall. 2(0 -6)
 P: CEM 262, BCH 462. R: Biochemistry
 majors or approval of department.
 Methods of molecular biology and the underlying
 principles on which these methods are based.
 QP: BCH 453 QA: BCH 405

490. **Research**
 Fall, Spring, Summer. 1 to 4 credits.
 May reenroll for a maximum of 3
 credits.
 R: Approval of department.
 Participation in laboratory or library research pro-
 jects.

499*. **Senior Thesis**
 Fall, Spring, Summer. 1 to 8 credits.
 May reenroll for a maximum of 8
 credits.
 P: Approval of department R: Senior
 Cumulative total credits in BCH 490 & 499 may not
 exceed 8
 Laboratory research culminating in submission of a
 thesis.
 QA: BCH 499

521. **Medical Biochemistry**
 Fall. 5(5 -0)
 R: Graduate-professional students in
 colleges of Human and Osteopathic Medicine.
 Basic biochemical principles and terminology: metabo-
 lism and function of biomolecules of importance in
 medical biology and processes pertinent to human
 pathophysiology.

801*. **Molecular Biology and Protein
 Structure**
 Fall. 4(4 -0)
 P: BCH 462, CEM 352, CEM 333
 Organization of genes including recombination, regu-
 lation of gene expression, replication, and recombina-
 tion. Protein structure and relationship of function to
 structure.
 QP: BCH 453 CEM 353CEM 384 QA:
 BCH811 BCH812

802*. **Metabolic Regulation and
 Molecular Endocrinology**
 Spring. 4(4 -0)
 P: BCH 801
 Molecular basis for metabolic regulation, molecular
 signalling mechanisms, and mechanisms for allosteric
 and covalent protein modifications.
 QP: BCH 453 CEM 353CEM 384BCH 811BCH 812
 QA: BCH 813

821*. **Biochemical Mechanisms and
 Structure**
 Spring. 3(3 -0)
 P: BCH 462, CEM 353, CEM 383 or
 concurrently
 Structures, methods of structural analysis, synthesis,
 and reaction mechanisms of biological substances
 including proteins, carbohydrates, lipids, porphyrins,
 phosphate esters, enzymes, and coenzymes.
 QP: CEM 353 BCH 453CEM 384 QA: BCH
 821

825*. **Cell Structure and Function**
 Spring. 3(3 -0) Interdepartmental
 with the Department(s) of Physiology,
 Microbiology and Public Health.
 P: BCH 461 or BCH 401
 Molecular basis of structure and function in cells.
 Fundamental properties of cells: reproduction, dynam-
 ic organization, integration, programmed and integra-
 tive information transfer considered through original
 investigations in all five kingdoms.
 QP: BCH 451 ORBCH 401 QA: BCH 825

829*. **Methods of Macromolecular
 Analysis and Synthesis**
 Fall. 2(2 -0)
 P: BCH 462
 Techniques of isolation and characterization of macro-
 molecule. Uses of the computer in structure-function
 analysis of macromolecule.
 QP: BCH 453 QA: BCH 829

831*. **Physiological Biochemistry**
 Spring. 4(4 -0)
 P: BCH 401 or BCH 462
 Mammalian physiological biochemistry; with metabo-
 lic interpretation of normal and altered physiological
 states of humans and other mammals.
 QP: BCH 401 QA: BCH 831 BCH 832

855*. **Special Problems**
 Fall, Spring, Summer. 1 to 4 credits.
 May reenroll for a maximum of 8
 credits.
 R: graduate level
 Laboratory or library research on special problems
 in biochemistry.

864*. **Plant Biochemistry**
 Spring. 3(3 -0) Interdepartmental
 with the Department(s) of Botany and
 Plant Pathology.
 P: BCH 401 or BCH 462
 Biochemistry unique to photosynthetic organisms.
 Photosynthetic and respiratory electron transport,
 nitrogen fixation, carbon dioxide fixation, lipid metabo-
 lism, carbon partitioning, cell walls, biosynthesis of
 plant hormones.
 QP: BCH 401 BOT 301 QA: BCH 864

888*. **Laboratory Rotation**
 Fall, Spring, Summer. 1 to 4 credits.
 May reenroll for a maximum of 12
 credits.
 R: graduate biochemistry
 Participation in research laboratories to learn bio-
 chemical techniques and research approaches, broaden
 research experience, and assess research interests
 prior to selecting a thesis adviser.

899*. **Master's Thesis Research**
 Fall, Spring, Summer. 1 to 4 credits.
 May reenroll for a maximum of 60
 credits.
 R: Master's level biochemistry

960*. **Selected Topics in Biochemistry**
 Fall, Spring. 1 to 2 credits. May
 reenroll for a maximum of 7 credits.

Topics from areas of biochemical genetics, biochemis-
 try of development, biochemical evolution, complex
 proteins, lipid metabolism, or other areas of contempo-
 rary biochemical research interest.

961*. **Selected Topics in Biochemistry**
 Fall, Spring. 1 to 2 credits. May
 reenroll for a maximum of 7 credits.

Topics from areas of bioenergetics, bioinstrumenta-
 tion, complex carbohydrates, mass spectrometry,
 biochemistry of isoprenoid compounds, or other areas
 of contemporary biochemical research interest.

978*. **Seminar in Biochemistry**
 Fall, Spring. 1(1 -0) May reenroll
 for a maximum of 5 credits.
 R: graduate biochemistry
 Seminars on research topics in biochemistry, mainly
 by visiting scientists.

999*. **Doctoral Dissertation Research**
 Fall, Spring, Summer. 1 to 4 credits.
 May reenroll for a maximum of 99
 credits.
 R: Ph.D. level biochemistry

BIOLOGICAL SCIENCE BS

110. **Organisms and Populations**
 Fall, Spring. 4(3 -3)
 Biological diversity and organismal biology. Princi-
 ples of evolution, population biology, and community
 structure.