310 Directed Studies
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 4 credits in all enrollments for this course. R: Approval of department.
Individual study or project in astronomy or astrophysics under the direction of a faculty member.

312 Observational Astronomy
Spring. 1(0-2) P: (AST 303 or AST 307) Basic observational techniques in astronomy. Stellar photometry and spectroscopy.

410 Senior Thesis
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 5 credits in all enrollments for this course. P:M: (AST 301) and completion of Tier I writing requirement. Design and execute an original experiment or computation. A written and oral report of the research is required.

800 Research Methods
Fall, Spring, Summer. 3(3-0) A student may earn a maximum of 12 credits in all enrollments for this course. P: (AST 801) Apprenticeship in astrophysical research. Student will work closely with faculty member to learn research techniques.

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.

802 Techniques of Modern Astrophysics
Fall, Spring. 3 credits. P: (AST 801) Students are introduced to modern astrophysics through participation in short projects involving literature surveys, professional planning, and research in observational, theoretical, and computational astrophysics.

805 Research Project
Fall, Spring. 3(3-0) A student may earn a maximum of 6 credits in all enrollments for this course. Research project to be completed under the guidance of an astronomy faculty member.

810 Radiation Astrophysics
Fall of odd years. 3(3-0) Transfer of radiation through plasmas and processes for emission and absorption of photons. Interpretation of the spectra of stars, the interstellar medium, and galaxies.

820 Advanced Topics in Astrophysics
Fall, Spring. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. P: (AST 801) Advanced work in a specialized astrophysical topic.

825 Galactic Astronomy
Fall of odd years. 3(3-0) The Milky Way as a galaxy. Observations and techniques of theoretical analysis that are used to discover the features of our galaxy.

835 Extragalactic Astronomy
Fall of even years. 3(3-0) Galaxies beyond the Milky Way. Large-scale structure of the universe. Cosmology.

840 Stellar Astrophysics
Spring of even years. 3(3-0) Physics of stellar interiors. Methods for calculating stellar models. Principles of stellar evolution.

850 Electrodynamics of Plasmas
Spring of odd years. 3(3-0) Interdepartmental with Electrical and Computer Engineering; Physics. Administered by Department of Electrical and Computer Engineering. R: (ECE 835 or PHY 488) SA: EE 850 Plasma kinetic and macroscopic plasma transport theory. Electromagnetic wave propagation and charged particle diffusion processes in plasma. Electromagnetic energy absorption via elastic and inelastic collisions. Dc, rf, and microwave discharges.

860 Gravitational Astrophysics
Fall. 3(3-0) A student may earn a maximum of 6 credits in all enrollments for this course. R: (PHY 620 and PHY 641) 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.

861 Cosmology
Spring. 3(3-0) R: Open only to graduate students in the Department of Physics and Astronomy. SA: AST 860A 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.

899 Master's Thesis Research
Fall, Spring. 3(3-0) A student may earn a maximum of 36 credits in all enrollments for this course. R: Open only to graduate students in Astronomy and Astrophysics. MS Thesis Research

999 Doctoral Dissertation Research
Fall, Spring. 3(3-0) A student may earn a maximum of 120 credits in all enrollments for this course. R: Open only to doctoral students in Astronomy and Astrophysics. Doctoral dissertation research.

AUDIOLOGY AND SPEECH SCIENCES

Department of Audiology and Speech Sciences

College of Communication Arts and Sciences

203 Introduction to Communication Sciences and Disorders
Fall, Spring. 3(3-0) Open to students with credit in ASC 403. Survey of research and practice regarding speech, hearing and language disorders in children and adults.

214 Anatomy and Physiology of the Speech and Hearing Mechanism
Fall. 4(3-2) P: (ASC 203 or concurrently) Structural and functional aspects of the central and peripheral auditory mechanisms, and of the respiratory, pharyngeal, and articulatory mechanisms for speech.

232 Descriptive Phonetics
Fall, Spring. 2(1-2) Principles of speech production. Transcription of speech using the International Phonetic Alphabet.

303 Hearing Science
Fall. 3(2-2) P: (MTH 106 or MTH 152 or MTH 110 or MTH 201 or MTH 116 or STT 200 or MTH 124 or STT 201 or MTH 132) R: Completion of one ISP course. SA: ASC 255 Physical and psychological aspects of sound and their measurement. Emphasis on the understanding of human communication and its disorders.

313 Speech Science
Spring. 3(2-2) P: (ASC 214 and ASC 232 or concurrently) R: Completion of one ISP course SA: ASC 255 Processes underlying the production and perception of speech. Understanding human communication and its disorders.

333 Oral Language Development
Fall, Spring. 3(3-0) P: (PSY 101 or LIN 200 or LIN 401 or ENG 302) R: Not open to freshmen Development of receptive and expressive aspects of child language.

344 Evaluation Procedures in Audiology
Spring. 4(3-2) P: (ASC 303) and completion of Tier I writing requirement. Classification of hearing disorders. Behavioral and electrophysiologically measurement of hearing, including subjective and objective testing procedures.

364 Evaluation Procedures in Speech-Language Pathology
Fall. 4(3-2) P: (ASC 313) and completion of Tier I writing requirement. Evaluation procedures in speech-language pathology. Test procedures. Analysis of results. Report writing.

394 Observation and Analysis of Clinical Practice

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

419 International Aspects of Communication Disorders
Spring. Summer. 1 to 6 credits. A student may earn a maximum of 9 credits in all enrollments for this course. P: (ASC 214 and ASC 303 and ASC 313 and ASC 333) R: Approval of department. Human communication disorders in international settings.
<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>433</td>
<td>Language Dialect Differences in Applied Contexts</td>
<td>3(3-0)</td>
<td>Spring. Open only to graduate students in Audiology and Speech Sciences. Hypothesis generation, experimental design, data collection, data analysis and presentation.</td>
</tr>
<tr>
<td>434</td>
<td>Receptive Aural Perception</td>
<td>3(3-0)</td>
<td>Fall. Open only to graduate students in Audiology and Speech Sciences. Speech audiometry and speech-processing techniques.</td>
</tr>
<tr>
<td>443</td>
<td>Rehabilitation Audiology</td>
<td>3(3-0)</td>
<td>Fall. Open only to graduate students in Audiology and Speech Sciences. Methods for the rehabilitation of individuals with speech, language and hearing disorders.</td>
</tr>
<tr>
<td>453</td>
<td>Mind-Body Communication</td>
<td>3(3-0)</td>
<td>Fall. Open only to graduate students in Audiology and Speech Sciences. Principles of intervention in language disorders for children functioning at or below preschool levels, regardless of chronological age.</td>
</tr>
<tr>
<td>463</td>
<td>Intervention Procedures in Speech-Language Pathology</td>
<td>3(3-0)</td>
<td>Fall. Open only to graduate students in Audiology and Speech Sciences. Principles of intervention in language disorders for school-age children and adolescents functioning above preschool levels.</td>
</tr>
<tr>
<td>473</td>
<td>Phonological Disorders in Children</td>
<td>3(3-0)</td>
<td>Spring. Open only to graduate students in Audiology and Speech Sciences. Principles of intervention in language disorders for school-age children and adolescents functioning above preschool levels.</td>
</tr>
<tr>
<td>483</td>
<td>School-Based Communication Disorders Programs</td>
<td>3(3-0)</td>
<td>Spring. Open only to graduate students in Audiology and Speech Sciences. Principles of intervention in language disorders for school-age children and adolescents functioning above preschool levels.</td>
</tr>
<tr>
<td>490</td>
<td>Independent Study</td>
<td>1-4</td>
<td>Fall, Spring. Open only to graduate students in Audiology and Speech Sciences. Principles of intervention in language disorders for school-age children and adolescents functioning above preschool levels.</td>
</tr>
<tr>
<td>491</td>
<td>Topics in Communication Sciences and Disorders</td>
<td>3(2-2)</td>
<td>Fall. Open only to graduate students in Audiology and Speech Sciences. Principles of intervention in language disorders for school-age children and adolescents functioning above preschool levels.</td>
</tr>
<tr>
<td>494</td>
<td>Clinical Practicum in Communication Disorders</td>
<td>3(2-2)</td>
<td>Fall, Spring. Open only to graduate students in Audiology and Speech Sciences. Principles of intervention in language disorders for school-age children and adolescents functioning above preschool levels.</td>
</tr>
</tbody>
</table>

**Notes:**
- Courses are offered in the fall, spring, and summer semesters unless otherwise specified.
- Prerequisites vary by course.
- Some courses are open only to graduate students in Audiology and Speech Sciences.
- All courses require approval from the department.

**Additional Courses:**
- 823L Counseling in Communication Disorders
- 823X Augmentative Communication
- 833 Auditory Psychophysiology
- 843A Diagnostic Audiology I
- 843B Diagnostic Audiology II
- 843C Hearing Amplification
- 843E Pediatric Audiology
- 843J Medical Aspects of Speech-Language Pathology
- 843K Advanced Rehabilitative Audiology
- 843L Medical Aspects of Audiology

**Contact:**
For more information, contact the Department of Audiology and Speech Sciences at (ASC 333 or ASC 201) or (ASC 401 or ENG 302) for regional, ethnic, and cultural characteristics of American English, Comparison of speech-language differences and disorders.
843I  Hearing Amplification II  
Spring, 3(3-0) P:M: (ASC 843C) 
Advanced theoretical and clinical strategies for evaluating and fitting contemporary hearing aids. Assistive-listening devices, classroom amplification, hearing-aid dispensing, and contemporary clinical and research issues in amplification.

843J  Manual Communication for Clinical Settings  
Summer, 3(3-0) P:M: (ASC 344) 
Introduction to the use of manually cued English sign systems and Pidgin Sign English in diagnostic and treatment sessions.

90  Independent Study  
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course. R: Open only to M.A. students in Audiology and Speech Sciences. Approval of department. 
Individualized study under faculty direction.

894  Research Practicum in Communication Sciences and Disorders  
Fall, Spring, Summer. 1 credit. A student may earn a maximum of 12 credits in all enrollments for this course. R: Open only to graduate students in Audiology and Speech Sciences. 
Topical themes in human communication and its disorders.

994  Research Practicum in Communication Sciences and Disorders  
Fall, Spring, Summer. 1 credit. A student may earn a maximum of 12 credits in all enrollments for this course. R: Open only to graduate students in Audiology and Speech Sciences. 
Topical themes in human communication and its disorders.

999  Doctoral Dissertation Research  
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 99 credits in all enrollments for this course. R: Open only to Ph.D. students in Audiology and Speech Sciences. Approval of department. 
Doctoral dissertation research.

900  Master's Thesis Research  
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to graduate students in Audiology and Speech Sciences. Approval of department. 
M.S. thesis research.

914A  Clinical Practicum in Speech-Language Pathology  
Fall, Spring, Summer. 1 credit. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to graduate students in Audiology and Speech Sciences. Approval of department. 
Supervised clinical experience in the management of clients with speech-language disorders.

914B  Clinical Practicum in Audiology  
Fall, Spring, Summer. 1 credit. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to graduate students in Audiology and Speech Sciences. Approval of department. 
Supervised clinical experience in the management of clients with hearing disorders.

999  Doctoral Dissertation Research  
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course. R: Open only to Ph.D. students in Audiology and Speech Sciences. Approval of department. 
Doctoral dissertation research.

992  Seminar in Communication Sciences and Disorders  
Fall, Spring. 3(3-0) A student may earn a maximum of 12 credits in all enrollments for this course. R: Open only to graduate students in Audiology and Speech Sciences. 
Topical themes in human communication and its disorders.

499  Doctoral Dissertation Research  
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course. R: Open only to Ph.D. students in Audiology and Speech Sciences. Approval of department. 
Doctoral dissertation research.

490  Biochemistry Research  
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course. R: Total credits in BMB 490 and BMB 499 may not exceed 8. Approval of department. SA: BCH 490 
Participation in laboratory or library research projects.

495  Undergraduate Seminar  
Spring, 2(2-0) P:M: (BMB 462 or BMB 262) R: Open only to Biochemistry or Biotechnology majors or approval of department. SA: BCH 472 
Methods of molecular biology and the underlying principles on which these methods are based.

491  Biochemistry I  
Fall, 3(4-0) P:M: (CEM 252 or CEM 352) and (BS 110) and (MTH 124 or MTH 132 or MTH 152H or LBS 118) and (BS 111L or LBS 145 or LBS 158H or LBS 159H) SA: BCH 461 Not open to students with credit in BMB 200 or BMB 401. 
Protein structure and function, enzymology, bioenergetics, and intermediary metabolism.

472  Biochemistry Laboratory (W)  
Spring, 3(0-9) P:M: (BMB 401 or BMB 461) and (BS 110 and CEM 262 and CEM 356 and CSE 101) and (MTH 124 or MTH 132 or MTH 152H or LBS 118) and (BS 111L or LBS 145 or LBS 158H or LBS 159H) and completion of Tier I writing requirement. SA: BCH 471 
Biochemical methods and principles used in the study of enzymes (proteins), carbohydrates, lipids, and cell organelles.

471  Biochemistry Laboratory (W)  
Spring, 3(0-9) P:M: (BMB 401 or BMB 461) and (BS 110 and CEM 262 and CEM 356 and CSE 101) and (MTH 124 or MTH 132 or MTH 152H or LBS 118) and (BS 111L or LBS 145 or LBS 158H or LBS 159H) and completion of Tier I writing requirement. SA: BCH 471 
Biochemical methods and principles used in the study of enzymes (proteins), carbohydrates, lipids, and cell organelles.

490  Biochemistry Research  
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course. R: Total credits in BMB 490 and BMB 499 may not exceed 8. Approval of department. SA: BCH 490 
Participation in laboratory or library research projects.

495  Undergraduate Seminar  
Spring, 2(2-0) P:M: (BMB 462 or BMB 262) R: Open only to students in the Biochemistry or Biotechnology majors. SA: BCH 495 
Extension and synthesis of concepts of biochemistry. Relationships to societal issues.

499  Senior Thesis  
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course. R: Open only to students in the Biochemistry or the Biochemistry/Biotechnology major. Total credits in BMB 490 and BMB 499 may not exceed 8. Approval of department. SA: BCH 499 
Laboratory research culminating in a thesis.

514  Medical Biochemistry  
Fall. 3 credits. R: Restricted to students enrolled in M.D. (CHM) or D.O. (COM) programs. SA: BCH 514 Not open to students with credit in BMB 521. 
Basic biochemical principles and terminology; metabolism and function of biomolecules of importance in medical biology and human pathophysiology.