

# Astronomy

In the College of Sciences

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## Faculty

Emeritus: Angione, Daub, May, Nelson, Talbert, Young, A.

Chair: Etzel

Professors: Etzel (Director of Mt. Laguna Observatory), Shafter

Assistant Professors: Orosz, Sandquist, Welsh

Adjunct: Hood, Miller, Ringwald, Teare, Veal, Young, A.T.

## Offered by the Department

Master of Science degree in astronomy.

Major in astronomy with the B.A. degree in liberal arts and sciences.

Major in astronomy with the B.S. degree in applied arts and sciences.

Minor in astronomy.

## The Major

Will the universe expand forever? Is there life on other planets? How are stars formed? These are the types of questions being addressed by students majoring in astronomy. Some areas of study in astronomy include the sun, the solar system, the stars, the Milky Way, the galaxies, and cosmology.

SDSU is the only institution in The California State University system that offers a complete academic program in astronomy. Students actively participate in all phases of observational astronomical research.

Joint faculty and student research activities are principally in the area of observational astrophysics. These include ongoing investigations of cosmology, eclipsing binary stars, low mass stars, planetary nebulae, galactic clusters, exterior galaxies, and extrasolar planets.

Much of this work is done at the Mount Laguna Observatory operated by the University. Modern astronomical detectors are employed that produce digital data, which lend themselves to computer analysis. Faculty and students also participate in space astrophysics projects. The department has excellent computer facilities at the observatory and on-campus.

Graduates with a bachelor's degree are trained in the application of the scientific method to the realm of astronomy and astrophysics, which requires a good foundation of understanding of physics and mathematics. Additionally, our students obtain useful skills in computing applications and in the use of modern electronic instrumentation. Many of our graduates find employment in industry, with astronomical observatories, or with government agencies or government contractors. These jobs support continuing research and include telescope operators, instrument makers, opticians, electronic technicians, programmers, image analysts, and laboratory technicians. Some of our graduates pursue advanced degrees.

Employment opportunities for astronomers who have advanced degrees include positions in colleges and universities, in national observatories and government laboratories, in planetariums, and in industry and private companies.

## Astronomy Major

With the B.A. Degree in Liberal Arts and Sciences

(Major Code: 19111)

All candidates for a degree in liberal arts and sciences must complete the graduation requirements listed in the section of this catalog on "Graduation Requirements." No more than 48 units in astronomy courses can apply to the degree.

A minor is not required with this major.

**Preparation for the Major.** Astronomy 201; Mathematics 150, 151, 252; Physics 195, 195L, 196, 196L, 197, 197L. (28 units)

Recommended: Chemistry 200, Computer Science 106 or 107.

**Language Requirement.** Competency (equivalent to that which is normally attained through three consecutive semesters of college study) is required in one foreign language to fulfill the graduation requirement. Refer to the section of this catalog on "Graduation Requirements."

**Graduation Writing Assessment Requirement.** Completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better or passing the Writing Proficiency Assessment with a score of 10 or above.

**Major\*.** A minimum of 27 upper division units in astronomy and physics to include Astronomy 320, 350, 440, 450; Mathematics 342A; Physics 350, 354; and six units selected with the approval of the astronomy undergraduate adviser. Recommended: Physics 360, 400A, 406.

## Astronomy Major

With the B.S. Degree in Applied Arts and Sciences

(Major Code: 19111)

All candidates for a degree in applied arts and sciences must complete the graduation requirements listed in the section of this catalog on "Graduation Requirements."

**Preparation for the Major.** Astronomy 201; Mathematics 150, 151, 252; Physics 195, 195L, 196, 196L, 197, 197L. (28 units)

Recommended: Chemistry 200, Computer Science 106 or 107.

**Graduation Writing Assessment Requirement.** Completing one of the approved upper division writing courses (W) with a grade of C (2.0) or better or passing the Writing Proficiency Assessment with a score of 10 or above.

**Major\*.** A minimum of 36 upper division units in astronomy and physics to include Astronomy 320, 350, 440, 450, 498A, 498B; Physics 350, 354, 360, 400A; and nine units selected from Physics 311, 400B, 406, 410.

**Minor in Mathematics.** All candidates for the B.S. degree in astronomy must complete a minor in mathematics, to include Mathematics 342A, 342B, and three additional upper division units of electives in mathematics. Recommended: Mathematics 541; Statistics 551A.

## Astronomy Minor\*

The minor in astronomy consists of a minimum of 15 units to include Astronomy 201 and 12 upper division units selected from Astronomy 301, 310, 320<sup>+</sup>, 340<sup>+</sup>, 350<sup>+</sup>, 440<sup>+</sup>, 450<sup>+</sup>.

Courses in the minor may not be counted toward the major, but may be used to satisfy preparation for the major and general education requirements, if applicable. A minimum of six upper division units must be completed in residence at San Diego State University.

\* Mathematics 342A-342B may be substituted for Physics 340A-340B as prerequisite for physics courses, where appropriate.

+ Additional prerequisites required.

**Courses (ASTR)****LOWER DIVISION COURSES****ASTR 101. Principles of Astronomy (3) I, II, S**

Discover the universe: planets, stars, galaxies, and our place in the cosmos; the Big Bang; how stars shine; comets, meteors, nebulae, the Milky Way; black holes and other exotic objects. Not open to students with credit in Astronomy 201.

**ASTR 109. Astronomy Laboratory (1) I, II, S**

Three hours of laboratory.

Prerequisite: Credit or concurrent registration in Astronomy 101 or 201.

Demonstration of astronomical principles through observations with astronomical instruments and analysis of astronomical data. A nighttime field trip to Mount Laguna Observatory is required.

**ASTR 201. Astronomy for Science Majors (3) I**

Prerequisite: Satisfaction of the Entry-Level Mathematics requirement.

Directed toward students with a strong interest in science and mathematics. Understanding the night sky, introduction to the solar system, star formation and evolution, extrasolar planets, nature of the Milky Way and other galaxies, origin and fate of the universe. Students with credit in Astronomy 101 and 201 will receive a total of three units of credit toward graduation.

**ASTR 296. Experimental Topics (1-4)**

Selected topics. May be repeated with new content. See Class Schedule for specific content. Limit of nine units of any combination of 296, 496, 596 courses applicable to a bachelor's degree.

**UPPER DIVISION COURSES  
(Intended for Undergraduates)****ASTR 301. Cosmology and Gravitational Collapse (3)**

Prerequisite: Completion of the General Education requirement in Foundations II. A.1. Physical Sciences.

Einstein's theory of general relativity applied to problems of gravitational collapse (stellar evolution, neutron stars, black holes) and cosmology (origin and evolution of the universe).

**ASTR 310. Astrobiology and the Search for Extraterrestrial Life (3) I, II**

Prerequisites: Completion of the General Education requirement in Foundations II.A.1. Physical Sciences or II.A.2. Life Sciences.

Extraterrestrial life in our solar system and other planetary systems; formation of stars and planets; UFOs and SETI; origin and evolution of life on earth; life in extreme environments; cosmology and structure of universe.

**ASTR 320. Solar System Astronomy (3) II**

Prerequisites: Astronomy 201 and Physics 197, 197L.

Structures of the planets; their surfaces, atmospheres, and satellite systems; asteroids, comets, and meteoroids. The Sun, its structure, energy production, and influence in the solar system. Life in the solar system.

**ASTR 340. Spherical Astronomy (3) I**

Prerequisites: Credit or concurrent registration in Mathematics 252 and Physics 197.

Problems in spherical astronomy, astronomical coordinate systems, time, general precession, and introduction to celestial mechanics.

**ASTR 350. Astronomical Techniques (3) II**

Prerequisite: Astronomy 201.

Astronomical observation and optics. Data acquisition and reduction for modern astronomical instrumentation including photometry, direct imaging, and spectroscopy. Techniques for obtaining precise measurements and determining measurement uncertainties.

**ASTR 440. Astrophysics of Stars (3) I**

Prerequisites: Credit or concurrent registration in Mathematics 342A and Physics 354.

Radiative transfer theory, atmospheres of stars and the emergent spectrum, interior structure and evolution of stars, stellar pulsations.

**ASTR 450. Astrophysics of Star Systems (3) II**

Prerequisites: Credit or concurrent registration in Mathematics 342A and Physics 354.

Applications of physics in study of binary stars, star clusters, the interstellar medium and galactic structure, galaxies, and cosmology.

**ASTR 496. Experimental Topics (3)**

Selected topics. May be repeated once with new content. See Class Schedule for specific content. Limit of nine units of any combination of 296, 496, 596 courses applicable to a bachelor's degree.

**ASTR 498A. Senior Project (1) I, II**

Prerequisite: An acceptable master plan for graduation within one year.

Selection and design of individual projects.

**ASTR 498B. Senior Project (2) I, II**

Six hours of laboratory.

Prerequisite: Astronomy 498A.

Individual research project culminating in a final written report.

**ASTR 499. Special Study (1-3) I, II**

Prerequisite: Consent of instructor.

Individual study. Maximum credit six units.

**UPPER DIVISION COURSE  
(Also Acceptable for Advanced Degrees)****ASTR 596. Advanced Topics in Astronomy (2 or 3) I, II**

Prerequisite: Consent of instructor.

Selected topics in theoretical astronomy or astrophysics. May be repeated with new content upon approval of instructor. See Class Schedule for specific content. Limit of nine units of any combination of 296, 496, 596 courses applicable to a bachelor's degree. Maximum credit of six units of 596 applicable to a bachelor's degree. Maximum combined credit of six units of 596 and 696 applicable to a 30-unit master's degree.

**GRADUATE COURSES  
Refer to Bulletin of the Graduate Division.**