ASTRONOMY (ASTR)

**ASTR 115 Introduction to Astronomy (Units: 3)**
Designed for non-science majors (majors should take ASTR 300). Stonehenge; solar system; sun, stars and stellar evolution, pulsars; black holes; nebulae, galaxies, quasars, big bang, and expanding universe; search for extraterrestrial life. Opportunity for telescopic observation.

**Course Attributes:**
- B1: Physical Science

**ASTR 116 Astronomy Laboratory (Unit: 1)**
Prerequisite: ASTR 115 (may be taken concurrently).

Fundamentals of astronomical observation, including optics and spectroscopy. Planetarium exploration of the stars, sun, and moon. Opportunity for telescopic observation.

**Course Attributes:**
- B3: Lab Science

**ASTR 120 Introduction to Astrobiology: Life in the Universe (Units: 3)**
Prerequisite: Completion of ELM requirement.

A scientifically quantitative and rigorous examination of topics and processes in astronomy, geology, and biology that bear on the possible formation and evolution of life on other planets. Motivated by the discovery of exoplanets and life in extreme environments.

**ASTR 300 Stars, Planets, and the Milky Way (Units: 3)**
Prerequisite: PHYS 220 or PHYS 111 with a grade of C- or better.

Quantitative study of stars, stellar evolution, and the Milky Way; emphasis on the observational basis of our knowledge of the Galaxy's structure and contents. Application of Newton's laws to exoplanets, determination of stellar masses, and evidence for dark matter. (Plus-minus letter grade only)

**ASTR 301 Observational Astronomy Laboratory (Units: 2)**
Prerequisites: ASTR 115 or ASTR 300, PHYS 220 or PHYS 111, with grades of C- or better.

Principles and practices of astronomical observation including telescope and detector design and operation; coordinate and magnitude systems; collection, analysis, and presentation of astronomical data.

**ASTR 340GW The Big Bang - GWAR (Units: 3)**
Prerequisites: ENG 214 or equivalent with a grade of C or better, PHYS 320 or equivalent with a grade of C- or better.

Introduction to cosmology, from earlier human conceptions of the universe, through the hot big bang and inflation; early universe, nucleosynthesis, dark matter, dark energy, photon, and neutrino backgrounds, and observational tests of cosmology. (ABC/NC grading only)

(This course is offered as ASTR 340GW and PHYS 340GW. Students may not repeat the course under an alternate prefix.)

**Course Attributes:**
- Graduation Writing Assessment

**ASTR 341 Planetarium Training (Unit: 1)**
Prerequisites: ASTR 115, ASTR 116, and consent of instructor.

Planetarium operation, understanding of night sky. Speaking and writing for public and education programs. Laboratory.

**ASTR 400 Stellar Astrophysics (Units: 3)**
Prerequisites: CSC 309, MATH 245 or MATH 376, PHYS 320, all with grades of C- or better.

Introduction to stellar astrophysics: the birth, life, and death of stars; stellar atmospheres and spectra; stellar interiors; energy generation and transport; star formation; stellar evolution and death; the Solar Cycle and the Sun-Earth connection.

(AXR 700/ASTR 400 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

**ASTR 405 Exoplanetary Science (Units: 3)**
Prerequisites: ASTR 115, PHYS 220, PHYS 330, or consent of instructor.

Study of extra-solar planets including history, detection methods, planet formation, and exoplanetary atmospheres. Exploration of statistics of exoplanetary systems, habitability, and placing the Solar System in a larger context.

**ASTR 470 Observational Techniques in Astronomy (Units: 3)**
Prerequisites: ASTR 300, ASTR 301 recommended, CSC 309 strongly recommended, all with grades of C- or better.

Astronomical instrumentation and data analysis; statistical analysis, CCD photometry, spectroscopy, image processing, instrument design. Classwork, 2 unit; laboratory, 1 unit.

[Formerly paired with ASTR 770. Students who complete the course at one level may not repeat the course at the other level.]

**ASTR 498 Astronomy Research Literature (Units: 2)**
Prerequisites: ASTR 300, PHYS 320, with grades of C- or better, or consent of instructor.

Critical reading and analysis of current literature in astronomy and astrophysics. Culminating experience for undergraduates.

(AXR 798/ASTR 498 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

**ASTR 685 Projects in the Teaching of Astronomy (Unit: 1)**
Prerequisite: ASTR 301 or ASTR 470 with a grade of B or better and consent of instructor.

Methods for effective student teaching in the SF State Observatory and/or Planetarium. Leading of Observatory Open Nights; development and/or presentation of Planetarium shows. May be repeated for a total of 3 units.

(Students may earn a maximum of 4 units toward the baccalaureate degree for any course(s) numbered 685 regardless of discipline.)

**ASTR 697 Senior Project (Units: 1-3)**
Prerequisites: ASTR 301 or ASTR 470 with a grade of C- or better.

Culminating experience for the B.S. in Physics: Concentration in Astrophysics. Observational or theoretical projects under the direction of department faculty. Student must submit a written report of work accomplished. May be repeated for a total of 6 units.

**ASTR 699 Independent Study (Units: 1-3)**
Prerequisites: Approval of department and consent of instructor; for advanced students majoring or minoring in astronomy or astrophysics.

Special study in the laboratory, field, or library under the direction of a member of the astronomy faculty. The student must present a written report of the work accomplished to the faculty and to the department. May be repeated for a maximum of 12 units.
ASTR 700 Stellar Astrophysics (Units: 3)
Prerequisites: CSC 309, MATH 245 or MATH 376, PHYS 320, all with grades of C- or better.

Introduction to stellar astrophysics: the birth, life, and death of stars; stellar atmospheres and spectra; stellar interiors; energy generation and transport; star formation; stellar evolution and death; the Solar Cycle and the Sun-Earth connection.

(ASTR 700/ASTR 400 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)

ASTR 722 Radiative Processes and Gas Dynamics in Astrophysics (Units: 3)
Prerequisites: Graduate standing; ASTR 400, PHYS 370, PHYS 430, PHYS 460, or equivalents; PHYS 785 recommended.

Radiative transfer; bremsstrahlung, Compton scattering, and synchrotron radiation; fluid dynamics and astrophysical shocks. Applications may include accretion, star formation, galaxy formation, star and galaxy clusters, active galactic nuclei, jets, and cosmic ray acceleration.

ASTR 742 Galaxies and Cosmology (Units: 3)
Prerequisites: ASTR 300, PHYS 370, PHYS 430, or equivalents, ASTR 400 or equivalent recommended.

Formation and evolution of galaxies and large-scale structure. Models of hierarchical structure formation in a universe dominated by dark matter. Observational constraints from the discovery of the expansion of the universe to ongoing experiments probing the nature of dark energy.

ASTR 770 Observational Techniques in Astronomy Research (Units: 3)
Prerequisites: CSC 309 or equivalent with a grade of B- or better, ASTR 400 or ASTR 700 or equivalent.

Astronomical photometry, spectroscopy, and astrometry in the research context. Statistical analysis, observational research program design, proposal writing. [Formerly paired with ASTR 470. May not repeat the course at a different level.] Classwork, 2 unit; laboratory, 1 unit. (Plus-minus letter grade only)

ASTR 798 Astronomy Research Literature (Units: 2)
Prerequisites: ASTR 300, PHYS 320, with grades of C- or better, or consent of instructor.

Critical reading and analysis of current literature in astronomy and astrophysics. Culminating experience for undergraduates.

(�ASTR 798/ASTR 498 is a paired course offering. Students who complete the course at one level may not repeat the course at the other level.)