ASTRONOMY (ASTR)

**ASTR 115 Introduction to Astronomy (Units: 3)**
Prerequisite: Category I or II placement for QR/Math, or completion of GE Area B4, or MATH 197.

Introduction to topics in astronomy including Stonehenge, the solar system, the sun, stars, and stellar evolution, pulsars, black holes, nebulae; galaxies, quasars, the big bang, the expanding universe, and the search for extraterrestrial life. Includes the 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. Laboratory.

Course Attributes:
- B3: Lab Science

**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 and 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, and the collection, analysis, and presentation of astronomical data. Lecture, 1 unit; laboratory, 1 unit.

**ASTR 340GW The Big Bang - GWAR (Units: 3)**
Prerequisites: GE Area A2 and PHYS 320 with a grade of C- or better.

Introduction to cosmology from earlier human conceptions of the universe through the hot Big Bang. Topics include: measuring space and time, the cosmic distance ladder, gravitation, general relativity and the curvature of spacetime, expansion of the universe, large scale structure, the early universe, the cosmic microwave background, nucleosynthesis, dark matter, dark energy and the ultimate fate of the universe. Emphasis will be on how we know what we know about the universe, including observational and experimental evidence. (ABC/NC grading only)

Course Attributes:
- Graduation Writing Assessment

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

Planetarium operation and understanding of the night sky. Speaking and writing for public and education programs. Activity.

**ASTR 400 Stellar Astrophysics (Units: 3)**
Prerequisite for ASTR 700: Graduate standing or consent of the instructor.

Prerequisites for ASTR 400: Upper-division standing; CSC 309, MATH 245 or MATH 376, and PHYS 320 all with grades of C- or better; GPA of 3.0 or higher; or consent of the instructor.

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.

(ATE 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, and PHYS 330; or consent of the 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 with a focus on statistical analysis, CCD photometry, spectroscopy, image processing, and instrument design. Lecture, 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)**
Prerequisite for ASTR 798: Graduate standing or consent of the instructor.

Prerequisites for ASTR 498: Upper-division standing; ASTR 300 and PHYS 320 with grades of C- or better; GPA of 3.0 or higher; or consent of the instructor.

Critical reading and analysis of current literature in astronomy and astrophysics.

(ATE 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)**
Prerequisites: ASTR 301 or ASTR 470 with a grade of B or better; consent of the instructor.

Methods for effective student teaching in the SF State Observatory and/or Planetarium. Leading of Observatory Open Nights and the 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)**
Prerequisite: Senior standing.

Observational or theoretical projects under the direction of department faculty. A written report of the work accomplished is required. May be repeated for a total of 6 units.
ASTR 699 Independent Study (Units: 1-3)
Prerequisites: Advanced Astronomy and Astrophysics majors and minors; approval of the department and consent of the instructor.

Special study in the laboratory, field, or library under the direction of a faculty member. The student must present a written report of the work accomplished to the faculty member and the department. May be repeated for a maximum of 12 units.

ASTR 700 Stellar Astrophysics (Units: 3)
Prerequisite for ASTR 700: Graduate standing or consent of the instructor.
Prerequisites for ASTR 400: Upper-division standing; CSC 309, MATH 245 or MATH 376, and PHYS 320 all with grades of C- or better; GPA of 3.0 or higher; or consent of the instructor.

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.

(ATER 700/ATER 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, and PHYS 460 or equivalents; PHYS 785 recommended.

Examination of 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, and 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 and ASTR 400 or ASTR 700 or equivalent.

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

ASTR 798 Astronomy Research Literature (Units: 2)
Prerequisite for ASTR 798: Graduate standing or consent of the instructor.
Prerequisites for ASTR 498: Upper-division standing; ASTR 300 and PHYS 320 with grades of C- or better; GPA of 3.0 or higher; or consent of the instructor.

Critical reading and analysis of current literature in astronomy and astrophysics.

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