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 121 or PHYS 240 (may be taken concurrently).

Quantitative study of stars, stellar evolution, and the Milky Way with an 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.

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 permission of the instructor.
Prerequisites for ASTR 400: Upper-division standing; ASTR 300, CSC 309, MATH 245 or MATH 376, and PHYS 320, all with grades of C- or better; GPA of 3.0 or higher; or permission 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. (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 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.
(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.)

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 permission of the instructor.
Prerequisites for ASTR 400: Upper-division standing; ASTR 300, CSC 309, MATH 245 or MATH 376, and PHYS 320, all with grades of C- or better; GPA of 3.0 or higher; or permission 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. (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 in Astrophysics (Units: 3)
Prerequisite: Graduate standing or permission of instructor.

Fundamentals of radiative transfer; basic theory of radiation fields; radiation from moving charges; relativistic covariance and kinematics; bremsstrahlung; synchrotron radiation; Compton scattering; plasma effects; atomic structure; radiative transitions; molecular structure. Applications include stellar and planetary atmospheres, circumstellar disks, the interstellar medium, galaxies, active galactic nuclei, and the intergalactic medium.

ASTR 742 Galaxies and Cosmology (Units: 3)
Prerequisites: Graduate standing or permission of the instructor.

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: Graduate standing; ASTR 700; or permission of the instructor.

Astronomical photometry, spectroscopy, and astrometry in the context of research. Statistical analysis, observational research program design, and proposal writing. Seminar, 2 units; laboratory, 1 unit.

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.
(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.)

ASTR 895 Culminating Project (Units: 3)
Prerequisites: Advancement to Candidacy (ATC) and Proposal for Culminating Experience (PCE) forms must be approved by the Division of Graduate Studies before registration.

Independent and original culminating project in astronomy and astrophysics under faculty supervision leading to written project report and oral defense of the project. Culminating projects could include: development of new teaching/curricular modules, portfolios of science writing/journalism, internships in science museums/planetaria or industrial or national research labs, development of technical reports/manuals for new scientific instruments, etc. (CR/NC, RP)

ASTR 896 Directed Reading in Astronomy and Astrophysics (Units: 1-3)
Prerequisite: Graduate standing.

Readings/tutorials to achieve better understanding of specific topics based on individual student need. Focus on review and integration of core concepts in preparation for the comprehensive oral examination. (Does not count toward MS degree requirements.) (CR/NC grading only)

ASTR 896EXM Culminating Experience Examination (Units: 0-3)
Prerequisites: Advancement to Candidacy (ATC) and Proposal for Culminating Experience (PCE) forms must be approved by the Division of Graduate Studies before registration.

Comprehensive oral examination on core topics in astronomy and astrophysics. (CR/NC, RP)

ASTR 897 Research (Units: 1-3)
Prerequisite: Graduate standing.

Independent research under the supervision of faculty. May be repeated. (Plus-minus letter grade, CR/NC, RP)

ASTR 898 Master's Thesis (Units: 3)
Prerequisites: Advancement to Candidacy (ATC) and Proposal for Culminating Experience (PCE) forms must be approved by the Division of Graduate Studies before registration.

Independent and original experimental, observational, theoretical, or computational research in astronomy and astrophysics under faculty supervision leading to written Master's Thesis and oral defense of thesis. (CR/NC, RP)

ASTR 899 Independent Study (Units: 1-3)
Prerequisite: Graduate standing.

Independent study under the supervision of faculty. May be repeated. (Plus-minus letter grade, CR/NC, RP)