ASTRONOMY (ASTR)

ASTR 101. Introduction to the Sun and Its Planets. 3 Units.
This introductory astronomy course describes our solar system of planets and how astronomers develop our physical understanding about the universe. Topics include the properties of the Sun and planets; the formation of the solar system and how the planets have evolved over time; asteroids, comets, and dwarf planets; and a comparison of our solar system with new planetary systems being found around other stars. This course has no pre-requisites.

ASTR 103. Introduction to the Stars, Galaxies, and the Universe. 3 Units.
This introductory astronomy course describes the universe we live in and how astronomers develop our physical understanding about it. Topics covered include: the properties of stars; the formation, evolution, and death of stars; white dwarfs, pulsars, and black holes; spiral and elliptical galaxies; the Big Bang and the expansion of the Universe. This course has no pre-requisites.

ASTR 105. Introduction to Einstein's Universe. 3 Units.
This course is a descriptive introduction for the non-science major to Einstein's Special and General Theories of Relativity and how these theories have fundamentally altered our understanding of the universe. Topics discussed will include: time dilation, length contraction, the twin paradox, the warping of space-time, white dwarf stars, neutron stars, black holes, the structure and evolution of the universe. No mathematical background beyond simple algebra is needed. This course has no pre-requisites.

ASTR 107. Introduction to Life in the Universe. 3 Units.
This course is intended to introduce the non-scientist to the field of astrobiology - the interdisciplinary study of, and the search for, extraterrestrial life and the conditions for extraterrestrial life in the Universe. This course has no pre-requisites.

ASTR 151. Doing Astronomy. 1 Unit.
This course is intended to introduce students to how astronomy is done. The course will focus on the astronomical research process, the scientific community, and on career paths in astronomy. Course activities will include readings and class discussions focusing on various topics in modern astronomy, including ongoing research activity in the department. This course is largely intended for first- and second-year students considering majoring or minoring in astronomy, or pursuing a career in astronomy. Prereq: First- or second-year academic standing.

ASTR 221. Stars and Planets. 3 Units.

ASTR 222. Galaxies and Cosmology. 3 Units.

ASTR 306. Astronomical Techniques. 3 Units.
This course covers the techniques astronomers use to conduct research, including observations using ground- and space-based telescopes, computer simulations and other numerical methods, and statistical data mining of large on-line astronomical datasets. Offered as ASTR 306 and ASTR 406. Counts as SAGES Departmental Seminar. Prereq: ASTR 222.

ASTR 309. Astrophysics Seminar I. 1 Unit.
Selected topics in astronomy not covered ordinarily in courses. Presentation of talks by the students. Prereq: ASTR 222 or Requisites Not Met permission.

ASTR 310. Astrophysics Seminar II. 1 Unit.
Selected topics in astronomy not covered ordinarily in courses. Presentation of talks by students. Prereq: ASTR 222 or Requisites Not Met permission.

ASTR 311. Stellar Physics. 3 Units.
Radiative transfer, atomic and molecular opacities, and the observable properties of stars. Stellar interiors, nuclear processes, and energy generation. The evolution of stars of varying mass and production of the elements within supernovae explosions. Offered as ASTR 311 and ASTR 411. Prereq: ASTR 222.

ASTR 323. The Local Universe. 3 Units.

ASTR 328. Cosmology and the Structure of the Universe. 3 Units.

ASTR 333. Dark Matter. 3 Units.
This course will systematically explore the evidence for dark matter in the universe. Necessary physical theory and astronomical concepts will be developed as appropriate. Topics to be covered include gravitational dynamics, gravitational lensing, and hydrostatic equilibrium as probes of the gravitational potentials of extragalactic systems. Examples include the rotation curves of spiral galaxies, the Oort discrepancy in the local Galactic disk, the dynamics of pressure supported dwarf and giant elliptical galaxies, and the Local Group timing problem. In clusters of galaxies, the mass discrepancy is illustrated separately by measured velocity dispersions, the hydrostatic equilibrium of the hot intracluster medium, and both strong and weak gravitational lensing. On cosmic scales, the course will address evidence from the gravitating and baryonic mass content of the universe, the growth of large scale structure from the initially smooth cosmic microwave background, and the existence of large voids and large scale bulk flows. The course will describe the various dark matter halo models commonly employed and introduce the techniques of mass modeling. We will examine hypotheses for the nature of dark matter, both baryonic and non-baryonic, and discuss strategies for experimental detection of plausible dark matter candidates. Theories that seek to explain the observed mass discrepancies by means of modifying the Law of Gravity rather than invoking dark matter will be explored. Offered as ASTR 333 and ASTR 433. Prereq: PHYS 310 or requisites not met permission.

ASTR 351. Astronomy Capstone Project. 1 - 3 Units.
In the Astronomy Capstone, students pursue scientific projects based on experimental, theoretical or pedagogical research under the supervision of an astronomy faculty member. Students will provide regular oral and written progress reports over the course of the project, and final results are presented in the form of a research paper (or other suitable technical report) as well as an oral summary presentation at a public symposium. For this course to satisfy the University's SAGES Capstone requirement, a total of three credit hours are needed. Counts as SAGES Senior Capstone. Prereq: ASTR 222.
ASTR 369. Undergraduate Research. 1 - 3 Units.
Supervised research on topics of interest. Can be used as a thesis course if desired. Students may register more than once for a maximum of 9 credits overall (1-3 credits each semester).

ASTR 406. Astronomical Techniques. 3 Units.
This course covers the techniques astronomers use to conduct research, including observations using ground-and space-based telescopes, computer simulations and other numerical methods, and statistical data mining of large on-line astronomical datasets. Offered as ASTR 306 and ASTR 406. Counts as SAGES Departmental Seminar.

ASTR 411. Stellar Physics. 3 Units.
Radiative transfer, atomic and molecular opacities, and the observable properties of stars. Stellar interiors, nuclear processes, and energy generation. The evolution of stars of varying mass and production of the elements within supernovae explosions. Offered as ASTR 311 and ASTR 411.

ASTR 423. The Local Universe. 3 Units.

ASTR 428. Cosmology and the Structure of the Universe. 3 Units.

ASTR 433. Dark Matter. 3 Units.
This course will systematically explore the evidence for dark matter in the universe. Necessary physical theory and astronomical concepts will be developed as appropriate. Topics to be covered include gravitational dynamics, gravitational lensing, and hydrostatic equilibrium as probes of the gravitational potentials of extragalactic systems. Examples include the rotation curves of spiral galaxies, the Oort discrepancy in the local Galactic disk, the dynamics of pressure supported dwarf and giant elliptical galaxies, and the Local Group timing problem. In clusters of galaxies, the mass discrepancy is illustrated separately by measured velocity dispersions, the hydrostatic equilibrium of the hot intracluster medium, and both strong and weak gravitational lensing. On cosmic scales, the course will address evidence from the gravitating and baryonic mass content of the universe, the growth of large scale structure from the initially smooth cosmic microwave background, and the existence of large voids and large scale bulk flows. The course will describe the various dark matter halo models commonly employed and introduce the techniques of mass modeling. We will examine hypotheses for the nature of dark matter, both baryonic and non-baryonic, and discuss strategies for experimental detection of plausible dark matter candidates. Theories that seek to explain the observed mass discrepancies by means of modifying the Law of Gravity rather than invoking dark matter will be explored. Offered as ASTR 333 and ASTR 433.

ASTR 497. Special Topics in Astronomy. 1 - 3 Units.

ASTR 601. Research. 1 - 18 Units.
Original research under the guidance of the staff.

ASTR 651. Thesis M.S.. 1 - 18 Units.
(Credit as arranged.) Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

ASTR 701. Dissertation Ph.D.. 1 - 9 Units.
(Credit as arranged.) Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.