

ASTRONOMY AND ASTROPHYSICS (ASTRO)

Courses primarily for undergraduates:

ASTRO 1020: North Star Astronomy

Credits: 1. Contact Hours: Lecture 1.

An entirely web-based course covering topics in observing the sky and navigation by the stars for students with little or no previous experience. The course combines material on common naked-eye phenomena, such as daily and seasonal variations in the sky, with information on how these helped navigators determine where they are on Earth. The course "lectures" are on-line, interactive units with built-in exercises, hands-on (offline) activities and layers of help. Graded homework and quizzes are administered via Canvas. Graduation Restriction: Students who take ASTRO 1200 may count credit in only one of ASTRO 1020 or 1030 toward graduation. (Typically Offered: Fall, Spring, Summer)

ASTRO 1030: Evening Star

Credits: 1. Contact Hours: Lecture 1.

An entirely web-based course covering topics in celestial mechanics ("Rocket science!") for students with little or no previous experience. It combines the geography of the solar system with discussion of methods of traveling to the other planets. The course "lectures" are on-line, interactive units with built-in exercises, hands-on (offline) activities, and layers of help. Graded homework and quizzes are administered via Canvas. Graduation Restriction: Students who take ASTRO 1200 may count credit in only one of ASTRO 1020 or 1030 toward graduation. (Typically Offered: Fall, Spring, Summer)

ASTRO 1200: The Sky and the Solar System

Credits: 3. Contact Hours: Lecture 2, Discussion 1.

For the nonscientist. A survey of our view of the universe, and the exploration of the solar system and beyond. The sky: constellations; motions of the Sun, Moon, and planets; seasons and the calendar; eclipses. The solar system: origin and evolution; characteristics of the Sun, planets, satellites, comets, meteorites, and asteroids. The detection and characterization of other solar systems, and the search for life in the universe. Extensive use of the planetarium is included. (Typically Offered: Fall, Spring, Summer)

ASTRO 1500: Stars, Galaxies, and Cosmology

Credits: 3.

For the nonscientist. A survey of astronomy with a focus on the universe beyond our solar system. Basic observational astronomy and the history of astronomy. Stellar astronomy: motions, distances, sizes, spectra; types of stars; variability; binary systems. Stellar evolution: the birth, life, and death of stars, including supernovae, neutron stars, and black holes. The structure and evolution of the Milky Way Galaxy. Other galaxies, clusters of galaxies, quasars. Theories of the origin of the universe. (Typically Offered: Fall, Spring)

ASTRO 2500: Astronomy Bizarre

Credits: 3. Contact Hours: Lecture 3.

Prereq: ASTRO 1200 or ASTRO 1500

For the nonscientist. A small enrollment course examining new and exciting topics in modern astronomy. Galaxy and star formation. Black holes and pulsars. Colliding galaxies. Quasars. Dark Matter. Dark energy. Quasars. Cosmology, the Big Bang and the future of the universe. Prospects and searches for extraterrestrial life. (Typically Offered: Spring)

ASTRO 2900: Independent Study

Credits: 1-4. Repeatable.

Prereq: Instructor Permission for Course

ASTRO 3420: Introduction to Solar System Astronomy

Credits: 3. Contact Hours: Lecture 3.

Prereq: (PHYS 2320 and PHYS 2320L) or PHYS 2420

An introduction to the physics of the Solar System and the planetary systems discovered around other stars. General characteristics of planetary systems: dynamics, thermodynamics, internal and surface structure of planets and minor bodies, physics of their atmosphere. Discovery techniques and characterization of extrasolar planets, and planetary systems formation models. 'Grand tour' of the Solar System, using data and imagery from probes and telescopes that have visited these worlds. The origin and evolution of life on Earth, and the ongoing search for life in the Solar System and elsewhere in the universe. (Typically Offered: Fall)

ASTRO 3440L: Astronomy Laboratory

Credits: 3. Contact Hours: Lecture 1, Laboratory 6.

Prereq: (PHYS 2320 and PHYS 2320L) or PHYS 2420

Experiments in optical astronomy. Observational techniques, ranging from stellar photometry to CCD imaging. Data processing and analysis techniques. Astronomical software packages and online databases and resources. Available instruments include a variety of small telescopes and astronomical CCD cameras. (Typically Offered: Fall)

ASTRO 3460: Introduction to Astrophysics

Credits: 3. Contact Hours: Lecture 3.

Prereq: (PHYS 2320 and PHYS 2320L) or PHYS 2420

An exploration of the universe beyond our Solar System, with emphasis on the astrophysics of stars and galaxies. Observable properties of stars, physics of stellar atmospheres and interiors. Birth, evolution and death of stars, to understand the past and future of our Sun, the Milky Way galaxy and the other galaxies in the universe. Basic concepts of cosmology, dark matter and dark energy. Use of computer models to calculate the structure and evolution of stars and protostars, and to analyze actual astronomical data obtained by professional astronomers. (Typically Offered: Spring)

ASTRO 4050: Astrophysical Cosmology

(Dual-listed with ASTRO 5050).

Credits: 3. Contact Hours: Lecture 3.

Prereq: ASTRO 3460 or permission of instructor

Introduction to modern cosmology and large-scale structure; mathematical and observational fundamentals associated with the origin, structure, and evolution of the Universe. Scale of the Universe, Hubble's Law, the cosmic microwave background, Big Bang nucleosynthesis, the origin of elements, dark energy and the accelerating universe, and dark matter. For senior undergraduates and graduate students in all areas of physics. (Typically Offered: Spring)

ASTRO 4500: Undergraduate Research

Credits: 1-6. Repeatable.

Prereq: Instructor Permission for Course

Research under supervision of astronomy faculty. (Typically Offered: Fall, Spring, Summer)

ASTRO 4500L: Undergraduate Research

Credits: 1-6. Repeatable.

Prereq: ASTRO 3440L and permission of instructor

Laboratory or observational project under supervision of astronomy faculty. (Typically Offered: Fall, Spring, Summer)

ASTRO 4900: Independent Study

Credits: 1-4. Repeatable, maximum of 9 credits.

Prereq: 6 credits ASTRO; permission of instructor

Graduation Restriction: No more than 9 credits of ASTRO 4900 may be counted toward graduation.

ASTRO 4900H: Independent Study: Honors

Credits: 1-4. Repeatable, maximum of 9 credits.

Prereq: 6 credits ASTRO; permission of instructor

Graduation Restriction: No more than 9 credits of ASTRO 4900 may be counted toward graduation.

Courses primarily for graduate students, open to qualified undergraduates:

ASTRO 5050: Astrophysical Cosmology

(Dual-listed with ASTRO 4050).

Credits: 3. Contact Hours: Lecture 3.

Introduction to modern cosmology and large-scale structure; mathematical and observational fundamentals associated with the origin, structure, and evolution of the Universe. Scale of the Universe, Hubble's Law, the cosmic microwave background, Big Bang nucleosynthesis, the origin of elements, dark energy and the accelerating universe, and dark matter. For senior undergraduates and graduate students in all areas of physics. (Typically Offered: Spring)

ASTRO 5100: Observational Astrophysics

Credits: 3. Contact Hours: Lecture 2, Laboratory 3.

Techniques in optical and near-IR astronomy, including spectroscopy and CCD photometry. Emphasis on projects involving proficiency in the use of research telescopes and modern instrumentation. Project topics range from photometric studies of pulsating and binary star systems to deep CCD imaging of faint nebulae and galaxies. Offered irregularly. (Typically Offered: Fall, Spring)

ASTRO 5800: Stellar Astrophysics

Credits: 3. Contact Hours: Lecture 3.

The interior structure and atmospheric properties of stars: Stellar structure equations and constitutive relations: energy generation, energy transport by radiation and convection; equation of state, nuclear energy generation and nucleosynthesis. Numerical and analytic solutions to the equations of structure and evolution. Observational connections through the theory of radiative transfer. Line and continuum processes and sources of opacity. Non-LTE and statistical equilibrium. Line profiles. Interpretation of stellar spectra: temperature, pressure, and abundance determinations. Stellar evolution from formation to final phases. Offered irregularly. (Typically Offered: Fall, Spring)

ASTRO 5820: High Energy Astrophysics

Credits: 3. Contact Hours: Lecture 3.

Prereq: ASTRO 4050 or ASTRO 5050 or Permission of Instructor

Interactions of high-energy particles, non-thermal radiation processes, spectral evolution of non-thermal systems, cosmic rays, active galactic nuclei, pulsars, neutrinos, measurement techniques for relativistic charged particles, high energy photons, and neutrinos. Offered irregularly. (Typically Offered: Fall, Spring)

ASTRO 5840: Galactic Astronomy

Credits: 3. Contact Hours: Lecture 3.

Overall structure of our Galaxy and the interstellar medium. Physical processes in the interstellar medium (e.g., heating and cooling mechanisms, turbulence). Observational techniques for studying the interstellar medium. Kinematics and chemical evolution of the Galaxy. Offered irregularly. (Typically Offered: Fall, Spring)

ASTRO 5860: Extragalactic Astronomy

Credits: 3. Contact Hours: Lecture 3.

Galaxy evolution, dynamics of external galaxies, evolution and classification of galaxies, groups and clusters of galaxies, extragalactic radio sources, quasars, structure formation, cosmological models and their observational consequences. Offered irregularly. (Typically Offered: Fall, Spring)

ASTRO 5900: Special topics

Credits: 1-30. Repeatable.

Prereq: Instructor Permission for Course

ASTRO 5990: Creative Component

Credits: 1-30.

Prereq: Instructor Permission for Course

Individually directed study of research-level problems for students electing the nonthesis M.S. option in astronomy.

Courses for graduate students:**ASTRO 6500: Advanced Seminar**

Credits: 1. Contact Hours: Lecture 1.

Repeatable.

Topics of current interest in astronomy and astrophysics. Offered on a satisfactory-fail basis only. (Typically Offered: Fall, Spring)

ASTRO 6750: Advanced Stellar Astrophysics

Credits: 3. Contact Hours: Lecture 3.

Prereq: ASTRO 5800 or Permission of Instructor

Advanced topics in stellar astrophysics. Dynamic and extended atmospheres, chromospheres, coronae, and stellar winds. MHD, stellar activity, and dynamo theory. Radiative transfer and the transition from extended atmospheres to the interstellar medium. Diffusive processes in stellar atmospheres and interiors. Techniques for quantitative analysis of planetary and stellar spectra including detailed modeling and spectrum synthesis. Evolution in interacting binaries. Nucleosynthesis II. Variable stars. Supernovae. Neutron stars and black holes. Offered irregularly. (Typically Offered: Fall, Spring)

ASTRO 6990: Research

Credits: 1-30. Repeatable.

Prereq: Instructor Permission for Course