

Astronomy and Astrophysics (ASTRO)

Courses primarily for undergraduates:

ASTRO 102. North Star Astronomy.

Cr. 1. F.S.

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 Web-CT. Students who take Astro 120 may count credit in only one of Astro 102 or 103 toward graduation.

ASTRO 103. Evening Star.

Cr. 1. F.S.

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 WebCT. Students who take Astro 120 may count credit in only one of Astro 102 or 103 toward graduation.

ASTRO 106. Earth and Space Science for Elementary Education Majors.

(Cross-listed with GEOL). (2-0) Cr. 2. F.S. *Prereq: Major in elementary or early childhood education.*

Fundamental concepts of Earth and Space Science, including the solar system, weather and climate, water and soils, plate tectonics, and geologic hazards. Online course format.

ASTRO 106L. Earth and Space Science for Elementary Education Majors: Laboratory.

(Cross-listed with GEOL). (0-2) Cr. 1. F.S. *Prereq: Restricted to elementary and early childhood education majors; to be taken concurrently with GEOL 106/ASTRO 106*

Inquiry-based lab exploring fundamental concepts of Earth and Space Science, including the solar system, weather and climate, water and soils, plate tectonics, and geologic hazards. Must be taken concurrently with GEOL/ASTRO 106.

ASTRO 120. The Sky and the Solar System.

(3-0) Cr. 3. F.S.SS.

For the nonscientist. 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. Extensive use of the planetarium is included. Students who take Astro 120 may count credit in only one of Astro 102 or 103 toward graduation.

ASTRO 125L. The Sky and the Solar System Laboratory.

(0-2) Cr. 1. F.S. *Prereq: Concurrent or previous enrollment in ASTRO 120* Laboratory course to accompany Astro 120. Students carry out practical exercises involving naked eye and telescopic observing to explore and reinforce ideas covered in Astro 120. Activities based on a sky-simulation computer program and other weather-independent exercises are also included.

ASTRO 150. Stars, Galaxies, and Cosmology.

(3-0) Cr. 3. F.S.

For the nonscientist. Observational aspects of 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 Milky Way Galaxy: clouds of matter in space, the structure and evolution of our galaxy. Other galaxies, clusters of galaxies, quasars. Theories of the origin of the universe.

ASTRO 250. Astronomy Bizarre.

(3-0) Cr. 3. S. *Prereq: ASTRO 120 or ASTRO 150*

For the nonscientist. New and exciting topics in modern astronomy. Galaxy and star formation. Black holes and pulsars. Colliding galaxies. Quasars. Cosmology, the Big Bang and the future of the universe. Prospects and searches for extraterrestrial life.

ASTRO 290. Independent Study.

Cr. 1-4. Repeatable. *Prereq: Permission of instructor*

ASTRO 342. Introduction to Solar System Astronomy.

(3-0) Cr. 3. F. *Prereq: PHYS 222*

Analytical and comparative studies of solar system objects-planets, satellites, rings, asteroids, comets, meteoroids, and interplanetary dust-with emphasis on the physical processes affecting them, their interactions, and their evolution. Orbital mechanics, including perturbations, stability, and resonances. Tidal forces and effects. Radiation laws and thermal physics with applications. Brief study of the sun as a star, and of stellar evolution. Origin and evolution of the solar system. Detection of other planetary systems. Nonmajor graduate credit.

ASTRO 344L. Astronomy Laboratory.

(1-6) Cr. 3. F. *Prereq: PHYS 222*

Experiments in optical astronomy. Observational techniques, ranging from stellar photometry to CCD imaging. Available instruments include a variety of small telescopes up to 14-inch in size. Class meets at Fick Observatory south of Boone. Nonmajor graduate credit.

ASTRO 346. Introduction to Astrophysics.

(3-0) Cr. 3. S. *Prereq: PHYS 222*

Basic radiation theory; spectra. Observational determination of stellar properties; spectral classification. Binary systems. Stellar structure and evolution. White dwarfs, neutron stars, black holes. The Galaxy: structure and composition; the interstellar medium. Other galaxies; active galaxies; cosmology. Nonmajor graduate credit.

ASTRO 405. Astrophysical Processes.

(Dual-listed with ASTRO 505). (3-0) Cr. 3. F. *Prereq: ASTRO 346 or permission of instructor*

Survey of astrophysical processes relating to stars, galaxies and the Universe. Radiation transport, radiation processes, scattering, kinetic description of plasma, hydrodynamics, magnetohydrodynamics, MHD waves, shocks, properties of systems in local thermodynamic equilibrium, non-thermal systems, astrophysical effects of general relativity.

ASTRO 450. Undergraduate Research.

Cr. 1-6. Repeatable. F.S.SS. *Prereq: Permission of instructor* Research under supervision of astronomy faculty.

ASTRO 450L. Undergraduate Research.

Cr. 1-6. Repeatable. F.S.SS. *Prereq: ASTRO 344L and permission of instructor* Laboratory or observational project under supervision of astronomy faculty.

ASTRO 490. Independent Study.

Cr. 1-4. Repeatable, maximum of 9 credits. *Prereq: 6 credits in astronomy, permission of instructor*

No more than 9 credits of Astro 490 may be counted toward graduation.

ASTRO 490H. Independent Study: Honors.

Cr. 1-4. Repeatable, maximum of 9 credits. *Prereq: 6 credits in astronomy, permission of instructor*

No more than 9 credits of Astro 490 may be counted toward graduation.

Courses primarily for graduate students, open to qualified undergraduates:

ASTRO 505. Astrophysical Processes.

(Dual-listed with ASTRO 405). (3-0) Cr. 3. F. *Prereq: ASTRO 346 or permission of instructor*

Survey of astrophysical processes relating to stars, galaxies and the Universe. Radiation transport, radiation processes, scattering, kinetic description of plasma, hydrodynamics, magnetohydrodynamics, MHD waves, shocks, properties of systems in local thermodynamic equilibrium, non-thermal systems, astrophysical effects of general relativity.

ASTRO 510. Observational Astrophysics.

(2-3) Cr. 3. Alt. F., offered 2011. *Prereq: ASTRO 405 or ASTRO 505*

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.

ASTRO 580. Stellar Astrophysics.

(3-0) Cr. 3. Alt. S., offered 2013. *Prereq: ASTRO 405 or ASTRO 505*

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.

ASTRO 582. High Energy Astrophysics.

(3-0) Cr. 3. Alt. F., offered 2012. *Prereq:* ASTRO 405 or ASTRO 505
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.

ASTRO 584. Galactic Astronomy.

(3-0) Cr. 3. Alt. S., offered 2012. *Prereq:* ASTRO 405 or ASTRO 505
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.

ASTRO 586. Extragalactic Astronomy.

(3-0) Cr. 3. Alt. F., offered 2011. *Prereq:* ASTRO 405 or ASTRO 505
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.

ASTRO 590. Special topics.

Cr. arr. Repeatable.

ASTRO 599. Creative Component.

Cr. arr. *Prereq:* *Permission of instructor*
Individually directed study of research-level problems for students electing the nonthesis M.S. option in astronomy.

Courses for graduate students:

ASTRO 650. Advanced Seminar.

(1-0) Cr. 1. Repeatable. F.S.
Topics of current interest in astronomy and astrophysics. Offered on a satisfactory-fail basis only.

ASTRO 660. Advanced Topics in Astronomy and Astrophysics.

Cr. 1-3. Repeatable. F.S.
Topics in stellar, galactic, and extragalactic astronomy, including stellar evolution, solar physics, variable stars, compact objects, the interstellar medium, active galaxies and quasars, formation and evolution of galaxies, cosmology, high energy astrophysics, advanced observational techniques, and astrophysical applications of hydrodynamics.

ASTRO 675. Advanced Stellar Astrophysics.

(3-0) Cr. 3. Alt. S., offered 2012. *Prereq:* ASTRO 405 or ASTRO 505; and ASTRO 580
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.

ASTRO 699. Research.

Cr. arr. Repeatable.