ASTRONOMY (ASTR)

ASTR Class Schedule (https://courses.illinois.edu/schedule/DEFAULT/DEFAULT/ASTR)

Courses

ASTR 100  Introduction to Astronomy  credit: 3 Hours.
One term introduction to astronomy. The nature of science; sun, planets, and moons; origin of the solar system; nature and evolution of stars; exploding stars; stellar remnants, including white dwarfs, neutron stars, and black holes; extrasolar planetary systems; galaxies and quasars; dark matter and dark energy; the Big Bang and the fate of the universe; and life in the universe. Lectures and observation; a field trip to Parkland Saerkel Planetarium may be required, nominal charge. Credit is not given for ASTR 100 if credit in any of ASTR 121, ASTR 122, ASTR 210, or equivalent has been earned. Students with credit in PHYS 211 are encouraged to take ASTR 210.
This course satisfies the General Education Criteria for:
UIUC: Physical Sciences

ASTR 121  The Solar System  credit: 3 Hours.
Introductory survey of the solar system; structure and motions of the earth and moon; planetary motions; natures and characteristics of the planets, and small solar system bodies (comets and asteroids); planetary moons and rings; meteors, meteoroids, and meteorites; properties of the Sun; origin and evolution of the solar system; comparison of our solar system to extrasolar planetary systems. Emphasis will be placed on problem-solving and scientific methods. Two lectures and one discussion each week, and observing sessions during the term. Credit is not given for ASTR 121 if credit for any of ASTR 100, ASTR 210, GEOL 116 has been earned. Students with credit in PHYS 211 are encouraged to take ASTR 210.
This course satisfies the General Education Criteria for:
UIUC: Physical Sciences

ASTR 122  Stars and Galaxies  credit: 3 Hours.
Introduction to celestial objects and phenomena beyond the solar system, and the governing basic physical principles; galaxies, quasars, and structure of the universe; dark matter and dark energy; the Big Bang and the fate of the universe; the Milky Way, the interstellar medium and the birth of stars; distances, motions, radiation, structure, evolution, and death of stars, including neutron stars and black holes. Emphasis will be placed on problem-solving and scientific methods. Two lectures and one discussion each week, and observing sessions during the term. Credit is not given for ASTR 122 if credit in either ASTR 100 or ASTR 210 has been earned. Students with credit in PHYS 211 are encouraged to take ASTR 210.
This course satisfies the General Education Criteria for:
UIUC: Physical Sciences

ASTR 131  The Solar System Lab  credit: 1 Hour.
Laboratory studies which complement the lecture course, ASTR 121. Laboratory exercises will include properties of telescopes, observations of the Moon and planets using telescopes at the Campus Observatory, and computer-based activities that illustrate modern astronomical techniques using digital data. Prerequisite: Credit in ASTR 100 or ASTR 121, or concurrent registration in ASTR 121.

ASTR 132  Stars and Galaxies Lab  credit: 1 Hour.
Laboratory studies which complement the lecture course, ASTR 122. Laboratory exercises will include properties of telescopes, observations of star clusters, nebulae and galaxies using telescopes at the Campus Observatory, and computer-based activities that illustrate modern astronomical techniques using digital data. Prerequisite: Credit in ASTR 100 or ASTR 122, or concurrent registration in ASTR 122.

ASTR 150  Killer Skies: Astro-Disasters  credit: 3 Hours.
Exploration of the most dangerous topics in the Universe, such as meteors, supernovae, gamma-ray bursts, magnetars, rogue black holes, colliding galaxies, quasars, and the end of the Universe, to name just a few.
This course satisfies the General Education Criteria for:
UIUC: Physical Sciences

ASTR 199  Undergraduate Open Seminar  credit: 1 to 5 Hours.
Approved for both letter and S/U grading. May be repeated.

ASTR 210  Introduction to Astrophysics  credit: 3 Hours.
Survey of modern astronomy for students with background in physics. Topics include: the solar system; nature and evolution of stars; white dwarfs, neutron stars, and black holes; galaxies, quasars and dark matter; large scale structure of the universe; the Big Bang; and Inflation. Emphasis will be on the physical principles underlying the astronomical phenomena. Prerequisite: PHYS 211.
This course satisfies the General Education Criteria for:
UIUC: Physical Sciences

ASTR 330  Extraterrestrial Life  credit: 3 Hours.
Scientific discussion of the search for extraterrestrial life. Topics include: cosmic evolution (protons to heavy elements to molecules); terrestrial evolution (chemical, biological, and cultural); high technology searches for extraterrestrial life in the solar system (Mars, Venus, outer planets); and beyond the solar system (Drake equation and current SETI projects).

ASTR 350  Introduction to Cosmology  credit: 3 Hours.
Descriptive course on modern cosmological theories. Topics include aspects of special and general relativity; curved spacetime; the Big Bang; inflation; primordial element synthesis; the cosmic microwave background; the formation of galaxies and large scale structure. Credit is not given for ASTR 350 if credit in ASTR 406 has been earned. Prerequisite: ASTR 100, or ASTR 121, or ASTR 210, or consent of instructor.

ASTR 390  Individual Study  credit: 0 to 4 Hours.
Individual study at an advanced undergraduate level. May be repeated in separate terms to a maximum of 8 hours. Prerequisite: Consent of advisor and of faculty member who supervises the work.

ASTR 401  Scientific Writing for Astronomy  credit: 2 Hours.
Development of journal-style writing skills. Papers written in accordance with the Astrophysical Journal Manual of Style on topics approved by the instructor. Emphasis on developing adequate and critical coverage of the topic, brevity compatible with clarity, and effective presentation. Proper referencing, footnotes, and bibliography are covered. 2 undergraduate hours. No graduate credit. Prerequisite: Completion of campus Composition I general education requirement. Concurrent enrollment in a designated 400-level astronomy course. Not intended for graduate students.
This course satisfies the General Education Criteria for:
UIUC: Advanced Composition
ASTR 404 Stellar Astrophysics  
**credit: 3 Hours.**
Introduction to astrophysical problems, with emphasis on underlying physical principles; includes the nature of stars, equations of state, stellar energy generation, stellar structure and evolution, astrophysical neutrinos, binary stars, neutron stars and pulsars, and novae and supernovae. 3 undergraduate hours. 3 graduate hours. Prerequisite: PHYS 212; or consent of instructor. Recommended: ASTR 210, PHYS 213, PHYS 214.

ASTR 405 Solar System and IS Medium  
**credit: 3 Hours.**
Physical processes in the solar system; dynamics of the solar system; physics of planetary atmospheres; individual planets; comets, asteroids, and other constituents of the solar system; extra-solar planets; formation of the solar system, stars, and planets; components of the interstellar medium; ionization and recombination; heating and cooling processes; comparison of theory with observations; composition and characteristics of interstellar dust; dynamics of the interstellar medium; interactions of stars with the interstellar medium: H II regions, planetary nebulae, and supernova remnants. 3 undergraduate hours. 3 graduate hours. Prerequisite: PHYS 212; or consent of instructor. Recommended: ASTR 210, PHYS 213, PHYS 214.

ASTR 406 Galaxies and the Universe  
**credit: 3 Hours.**
Nature of the Milky Way galaxy: stellar statistics and distributions, stellar populations, spiral structure, the nucleus and halo. Nature of ordinary galaxies; galaxies in our Local Group, structure of voids and superclusters. Nature of peculiar objects: Seyfert galaxies, starburst galaxies, and quasars. Elementary aspects of physical cosmology. 3 undergraduate hours. 3 graduate hours. Prerequisite: PHYS 212; or consent of instructor. Recommended: ASTR 210, PHYS 213, PHYS 214.

ASTR 414 Astronomical Techniques  
**credit: 4 Hours.**
Introduction to techniques used in modern optical and radio astronomy with emphasis on the physical and mathematical understanding of the detection of electromagnetic radiation; includes such topics as fundamental properties of radio and optical telescopes and the detectors that are used with telescopes. Lectures and laboratory. 4 undergraduate hours. 4 graduate hours. Prerequisite: MATH 241 or equivalent; PHYS 212; or consent of instructor. Recommended: ASTR 210, PHYS 213, PHYS 214.

ASTR 450 Astrochemistry  
**credit: 4 Hours.**
Same as CHEM 450. See CHEM 450.

ASTR 451 Astrochemistry Laboratory  
**credit: 3 or 4 Hours.**
Same as CHEM 451. See CHEM 451.

ASTR 490 Senior Thesis  
**credit: 3 Hours.**
Research with thesis, under the direction of a senior staff member in astronomy. This course is recommended for all students who plan to do research and graduate study, and it is a prerequisite for graduation with highest distinction in astronomy. In the term preceding their initial enrollment, those interested in taking the course should consult with their advisers and with the undergraduate adviser for the area of interest in which they plan to work. A thesis must be prepared for thesis to be received. 3 undergraduate hours. No graduate credit. Prerequisite: Two 400-level Astronomy courses. Consent of advisor and of staff member who supervises the work. Astronomy majors of senior standing.

ASTR 496 Seminar in Astronomy  
**credit: 1 to 4 Hours.**
Lectures on topics of current interest in astronomy and astrophysics; for advanced undergraduates and graduates. See Class Schedule for current topics. 1 to 4 undergraduate hours. 1 to 4 graduate hours. Approved for both letter and S/U grading. May be repeated. Prerequisite: Consent of instructor.

ASTR 499 Astronomy Laboratory  
**credit: 2 Hours.**
Provides hands-on observational experience: how to use a telescope, how to image sources using a modern CCD camera, how to use a modern CCD spectrometer, and how to apply data analysis to astrophysical problems. 2 undergraduate hours. 2 graduate hours. Prerequisite: One 400-level astronomy course.

ASTR 501 Radiative Processes  
**credit: 4 Hours.**
Fundamentals of radiative processes in astronomy. Topics include radiative transfer, classical theory of radiation fields, relativistic covariance and kinematics, synchrotron emission and absorption, bremsstrahlung, plasma effects, atomic and molecular spectroscopy, and dust. Prerequisite: ASTR 404 or consent of instructor.

ASTR 502 Astrophysical Dynamics  
**credit: 4 Hours.**
Introduction to stellar dynamics and fluid dynamics. Topics include two body collisions, two body relaxation, potential theory for stellar systems, adiabatic invariance, stellar system models, Jeans equations, and the virial theorem. Also hydrodynamics, magnetohydrodynamics, waves, instabilities, shocks, explosions, density waves, and wind-blown bubbles. Prerequisite: PHYS 436, PHYS 427, and PHYS 486; or consent of instructor.

ASTR 503 Observational Astronomy  
**credit: 4 Hours.**
Techniques and basic results of observational astronomy: gamma ray, x-ray, ultraviolet, visible, infrared, and radio astronomy; photometry, imaging, spectroscopy, and polarimetry; gravitational waves; cosmic rays; neutrinos; positional astronomy; noise; statistics; data analysis; optics. Prerequisite: Consent of instructor.

ASTR 504 Theoretical Stellar Physics  
**credit: 4 Hours.**
Application of physical principles to energy generation and flow in astrophysical environments: equations of state; thermonuclear reactions; radiative transport; convection; stellar spectra; nebular spectra; evolution of both single and binary stars; compact stars; accretion disks; thermal and particle history of the universe. Same as PHYS 542. Prerequisite: PHYS 436, PHYS 427, and PHYS 486; or consent of instructor.

ASTR 505 Star Formation  
**credit: 4 Hours.**
Survey of the current state of astrophysical research into the topic of star formation. Particular emphasis placed on interpreting observations and how they relate to the theory of star formation. Prerequisite: ASTR 405 or consent of instructor.

ASTR 506 Galaxies  
**credit: 4 Hours.**
Survey of the different constituents of the Universe, including galaxies, active galaxies, galaxy clusters, and intergalactic gas. Particular emphasis will be placed on observable properties of the Milky Way and other galaxies, as well as relating such observations to the understanding of the dynamics and evolution of galaxies. Prerequisite: ASTR 406 or consent of instructor.

ASTR 507 Physical Cosmology  
**credit: 4 Hours.**
A survey of the essentials of modern cosmology, providing an overview of the state of the field, of open questions, and of observational and theoretical tools. Topics include: classical cosmology--the Friedmann universe; the early universe--inflation, nucleosynthesis, dark matter; the cosmic microwave background--basic physics, anisotropies, polarization; large scale structure formation--theoretical models and observational tests; dark energy--observational evidence, theoretical ideas. Emphasizes applying physical principles to understand observations, and on using observations to constrain the nature of matter and spacetime on cosmic scales--viewing the universe as a laboratory for fundamental physics. Course work focuses heavily on problem solving. Prerequisite: ASTR 406 or consent of instructor.

*Information listed in this catalog is current as of 12/2015*
ASTR 510  Computational Astrophysics  credit: 4 Hours.
Prepares students to use numerical simulations to study complex problems in astrophysics and cosmology. Numerical methods and parallel computing will be covered together with the design, validation, and analysis of simulations. Emphasis is placed on solving ordinary and partial differential equations that arise in astrophysical contexts. Students work on assigned numerical problems and perform simulations using existing simulation codes, writing a final paper which presents the results of simulations using one of these codes. There are no formal prerequisites except knowledge of a scientific programming language such as Fortran, C, and C++. Familiarity with Unix/Linux and astronomical analysis tools is useful but not required.

ASTR 515  General Relativity I  credit: 4 Hours.
Same as PHYS 515. See PHYS 515.

ASTR 516  General Relativity II  credit: 4 Hours.
Same as PHYS 516. See PHYS 516.

ASTR 540  Astrophysics  credit: 4 Hours.
Same as PHYS 540. See PHYS 540.

ASTR 541  Physics of Compact Objects  credit: 4 Hours.
Same as PHYS 541. See PHYS 541.

ASTR 590  Individual Study  credit: 2 to 16 Hours.
Individual study or non-thesis research. May be repeated. Prerequisite: Consent of adviser and of faculty member who supervises the work.

ASTR 596  Seminar in Special Topics  credit: 0 to 16 Hours.
Approved for both letter and S/U grading. May be repeated. Prerequisite: Consent of instructor.

ASTR 599  Thesis Research  credit: 0 to 16 Hours.
Approved for S/U grading only. May be repeated.