ASTRONOMY

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The Department of Astronomy offers a major and a minor in astronomy. In addition, students may pursue astronomy as part of the LAS Major in Computer Science and Astronomy (http://catalog.illinois.edu/undergraduate/las/comp-science/astronomy).

The major in astronomy, administered by the Department of Astronomy, is based upon both a broad and an in-depth exploration into astronomy and allied disciplines, and is an excellent way to gain a general science education. It may be chosen by students who wish to have an astronomy research career or an astronomy background for use in related fields, such as working in national laboratories, observatories, planetariums, NASA, aerospace industry, many computer-related fields, journalism, or science writing to name a few. Astronomy courses can also be customized to satisfy a secondary field for the undergraduate curriculum in General Engineering.

Astronomy students are also encouraged to double major or minor in a second field such as chemistry, computer science, geology, mathematics or physics. Specific programs of study in other areas such as biology, economics, English, history, or journalism for individual students can be designed and periodically updated through mutual discussions between the students and their academic advisers.

The Department of Astronomy also sponsors the Minor in Astronomy.

For the Degree of Bachelor of Science in Liberal Arts and Sciences

Major in Astronomy
E-mail: astronomy@illinois.edu

Minimum required major and supporting course work normally equates to 47-48 hours.

General education: Students must complete the Campus General Education requirements (https://courses.illinois.edu) including the campus general education language requirement.

Twelve hours of 300- and 400-level Astronomy/Physics courses must be taken on this campus.

Minimum hours required for graduation: 120 hours

Departmental distinction. A student majoring in astronomy may earn distinction or high distinction by attaining a minimum grade point average of 3.4 or 3.75, respectively, in required major courses (defined in the table below) taken at UIUC. For highest distinction, in addition to meeting the minimum requirements for high distinction, a senior thesis (ASTR 490) must be completed with strong endorsement by the research supervisor. Questions about eligibility for distinction status should be directed to an astronomy advisor before the senior year.

Select three of the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTR 210</td>
<td>Introduction to Astrophysics 1</td>
<td>3</td>
</tr>
<tr>
<td>ASTR 404</td>
<td>Stellar Astrophysics</td>
<td>9</td>
</tr>
<tr>
<td>ASTR 405</td>
<td>Planetary Systems</td>
<td>12</td>
</tr>
<tr>
<td>ASTR 406</td>
<td>Galaxies and the Universe</td>
<td>10</td>
</tr>
<tr>
<td>ASTR 414</td>
<td>Astronomical Techniques</td>
<td>12</td>
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</tbody>
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Supporting Technical Courses

Physics

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>PHYS 211</td>
<td>University Physics: Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 212</td>
<td>University Physics: Elec &amp; Mag</td>
<td>6</td>
</tr>
<tr>
<td>PHYS 213</td>
<td>Univ Physics: Thermal Physics</td>
<td>9</td>
</tr>
<tr>
<td>PHYS 214</td>
<td>Univ Physics: Quantum Physics</td>
<td>6</td>
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</tbody>
</table>

Mathematics

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<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>MATH 221</td>
<td>Calculus I 4</td>
<td>9</td>
</tr>
<tr>
<td>MATH 231</td>
<td>Calculus II</td>
<td>12</td>
</tr>
<tr>
<td>MATH 241</td>
<td>Calculus III</td>
<td>18</td>
</tr>
</tbody>
</table>

1 Students without a background in physics or astronomy are encouraged to take ASTR 121 and ASTR 122 during their freshman year.
2 Other 300- or 400-level technical classes, e.g. chemistry, computer science engineering, or statistics can be substituted with academic adviser approval.
3 A maximum of 4 hours of credit in ASTR 390 (or equivalent "Independent Study" course, such as PHYS 497) can be counted towards this requirement.
4 MATH 220 may be substituted for MATH 221. MATH 220 is appropriate for students with no background in calculus.

Minor in Astronomy

The minor in astronomy is designed to broaden the student's knowledge of science and our place in the universe. The minor in Astronomy will benefit especially those students who are eager to learn astronomy but who do not anticipate it to be their career. The Astronomy minor is also suitable for students who intend to pursue careers in areas that may benefit from a good knowledge of astronomy such as aerospace industry, science writing, scientific journalism, or science teaching in schools.

E-mail: astronomy@illinois.edu

Code   Title                          Hours
Basic Astronomy

Select one of the following: 3-6

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>ASTR 100</td>
<td>Introduction to Astronomy 1</td>
<td>3</td>
</tr>
<tr>
<td>ASTR 121</td>
<td>Solar System and Worlds Beyond</td>
<td>6</td>
</tr>
<tr>
<td>&amp; ASTR 122 &amp; Stars and Galaxies 1</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>ASTR 210</td>
<td>Introduction to Astrophysics</td>
<td>3</td>
</tr>
</tbody>
</table>

Advanced Astronomy

300- or 400-level courses taught by the Department of Astronomy 2 9

Courses at any level taught by the Department of Astronomy 2 3-6

Minimum total hours 18

1 Credit not granted for both ASTR 100 and the ASTR 121/ASTR 122 sequence.
2 No more than 4 hours of ASTR 390 will be counted towards the minor.
ASTR Class Schedule (https://courses.illinois.edu/schedule/DEFAULT/DEFAULT/ASTR)

Courses

**ASTR 100  Introduction to Astronomy  credit: 3 Hours.** (https://courses.illinois.edu/schedule/terms/ASTR/100)
Introduces the student to the basic concepts of modern astronomy. Covers topics including the night sky, the solar system and its origin; the nature and evolution of 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. 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:
- Nat Sci Tech - Phys Sciences
- Quantitative Reasoning II

**ASTR 121  Solar System and Worlds Beyond  credit: 3 Hours.** (https://courses.illinois.edu/schedule/terms/ASTR/121)
Introductory survey of the Solar System; structure and motions of the Earth and Moon; planetary motions; natures and characteristics of the planets and smaller solar system bodies; planetary moons and rings; meteors, meteoroids, and meteorites; properties of the Sun; origin and evolution of the Solar System; discovery of extrasolar planetary systems; architecture of extrasolar planetary systems and comparison to our solar system; habitable extrasolar planets. Emphasis will be placed on problem-solving and scientific methods. Credit is not given for ASTR 121 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:
- Nat Sci Tech - Phys Sciences
- Quantitative Reasoning II

**ASTR 122  Stars and Galaxies  credit: 3 Hours.** (https://courses.illinois.edu/schedule/terms/ASTR/122)
Introduction to celestial objects and phenomena beyond the Solar System, and their 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; stellar distances, motions, radiation, structure, evolution, and remnants, including neutron stars and black holes. Emphasis will be placed on problem-solving and scientific methods. 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:
- Nat Sci Tech - Phys Sciences
- Quantitative Reasoning II

**ASTR 131  The Solar System Lab  credit: 1 Hour.** (https://courses.illinois.edu/schedule/terms/ASTR/131)
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.** (https://courses.illinois.edu/schedule/terms/ASTR/132)
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.** (https://courses.illinois.edu/schedule/terms/ASTR/150)
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:
- Nat Sci Tech - Phys Sciences

**ASTR 199  Undergraduate Open Seminar  credit: 0 to 5 Hours.** (https://courses.illinois.edu/schedule/terms/ASTR/199)
See course schedule for topics. Approved for Letter and S/U grading. May be repeated in the same term up to 5 hours or separate terms up to 8 hours, if topics vary.

**ASTR 210  Introduction to Astrophysics  credit: 3 Hours.** (https://courses.illinois.edu/schedule/terms/ASTR/210)
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:
- Nat Sci Tech - Phys Sciences

**ASTR 310  Computing in Astronomy  credit: 3 Hours.** (https://courses.illinois.edu/schedule/terms/ASTR/310)
An introduction to the use of computers in astrophysics research. Topics covered include a basic introduction to computing hardware concepts, Unix shell commands, programming in Python, data structures, astronomical libraries, modern software engineering concepts and tools, plotting and visualization of data, and fundamental numerical algorithms. Applications and examples drawn from astrophysics are stressed throughout. Prerequisite: PHYS 211; MATH 220; Credit or concurrent registration in ASTR 210.

**ASTR 330  Extraterrestrial Life  credit: 3 Hours.** (https://courses.illinois.edu/schedule/terms/ASTR/330)
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  The Big Bang, Black Holes, and the End of the Universe  credit: 3 Hours.** (https://courses.illinois.edu/schedule/terms/ASTR/350)
Studies the origin, evolution, and eventual fate of the universe, and the scientific tools used to study these issues. Topics include aspects of special and general relativity; curved spacetime; the Big Bang; inflation; primordial element synthesis; the cosmic microwave background; dark matter and the formation of galaxies; observational evidence for dark matter, dark energy, and black holes. Credit is not given for ASTR 350 if credit in ASTR 406 has been earned. Prerequisite: ASTR 100, or ASTR 121, or ASTR 122, or ASTR 210, or consent of instructor.

Information listed in this catalog is current as of 11/2018
ASTR 390  Individual Study  credit: 0 to 4 Hours. (https://courses.illinois.edu/schedule/terms/ASTR/390)
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. (https://courses.illinois.edu/schedule/terms/ASTR/401)
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: Advanced Composition

ASTR 404  Stellar Astrophysics  credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/ASTR/404)
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, white dwarfs, 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  Planetary Systems  credit: 3 Hours. (https://courses.illinois.edu/schedule/terms/ASTR/405)
This course traces, from a physical perspective, the evolution of planetary systems from star formation in molecular clouds to the emergence of habitable worlds. Topics include the properties of HII regions and molecular clouds, gravitational collapse and disk formation, formation of planetesimals and planets, dynamics of the solar system, physics of planetary atmospheres, properties of individual planets and their rings and satellites, detection and characterization of extra-solar planets, and searches for life in the Solar System and beyond. 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. (https://courses.illinois.edu/schedule/terms/ASTR/406)
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. (https://courses.illinois.edu/schedule/terms/ASTR/414)
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.

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