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).

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 Sciences and Letters Curriculum

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.

#### Astronomy Core

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTR 210</td>
<td>Introduction to Astrophysics</td>
<td>3</td>
</tr>
</tbody>
</table>

Select three of the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>9-10</td>
</tr>
</tbody>
</table>

### Supporting Technical Courses

#### Physics

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 211</td>
<td>University Physics: Mechanics</td>
<td>12</td>
</tr>
<tr>
<td>PHYS 212</td>
<td>University Physics: Elec &amp; Mag</td>
<td></td>
</tr>
<tr>
<td>PHYS 213</td>
<td>Univ Physics: Thermal Physics</td>
<td></td>
</tr>
<tr>
<td>PHYS 214</td>
<td>Univ Physics: Quantum Physics</td>
<td></td>
</tr>
</tbody>
</table>

#### Mathematics

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

Web address for department: http://www.astro.illinois.edu/

#### Basic Astronomy

Select one of the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTR 100</td>
<td>Introduction to Astronomy</td>
<td>3-6</td>
</tr>
<tr>
<td>ASTR 121</td>
<td>The Solar System</td>
<td></td>
</tr>
<tr>
<td>ASTR 122</td>
<td>and Stars and Galaxies</td>
<td></td>
</tr>
<tr>
<td>ASTR 210</td>
<td>Introduction to Astrophysics</td>
<td></td>
</tr>
</tbody>
</table>

#### Advanced Astronomy

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

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>9</td>
</tr>
</tbody>
</table>

Courses at any level taught by the Department of Astronomy

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>3-6</td>
</tr>
</tbody>
</table>

Minimum total hours

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>18</td>
</tr>
</tbody>
</table>

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.

Information listed in this catalog is current as of 03/2016
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 Staerkel 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 in 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
UIUC: Quant Reasoning II

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
UIUC: Quant Reasoning II

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 122, 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, 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** 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 presented for credit 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. 
This course satisfies the General Education Criteria for: UIUC: Advanced Composition

**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.