

## Astronomy

College of Science, Engineering and Technology  
 Department of Physics and Astronomy  
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 Web site: [www.mnsu.edu/physast](http://www.mnsu.edu/physast)

Chair: Mark A. Pickar

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The astronomy program serves the needs of a wide range of students, from those with only a casual interest in the subject to those students planning careers in the field. The 100-level courses (which include general education offerings) are designed to introduce astronomy to the student with a minimal background in mathematics and the physical sciences. The courses taken by astronomy majors and minors cover a variety of topics in modern astronomy and astrophysics and require significant preparation in mathematics and physics.

The astronomy major serves as the first step toward a career in teaching or research in astronomy. Students majoring in astronomy are strongly encouraged to consider a double major with physics, mathematics or computer science.

Admission to Major is granted by the department. Minimum university admission requirements are

- a minimum of 32 earned semester credit hours.

- a minimum cumulative GPA of 2.00 (C).

Contact the department for application procedures.

Many courses in the astronomy program require prerequisites. Students should consult the COURSE DESCRIPTIONS section of this bulletin to determine these courses.

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### ASTRONOMY BA

This major is intended to prepare the student for employment in a variety of roles in support of professional astronomy, rather than for graduate work.

Required General Education (9 credits):

MATH 121 Calculus I (4)

PHYS 221 General Physics I (5)

Required for Major (Support Courses, 21 credits):

MATH 122 Calculus II (4)

MATH 223 Calculus III (4)

MATH 321 Ordinary Differential Equations (4)

PHYS 222 General Physics II (5)

COMS 272 FORTRAN Programming (4)

Required for Major (Core, 30 credits):

AST 201 Spherical Astronomy (2)

AST 215 Astronomy and Astrophysics I (4)

AST 225 Astronomy and Astrophysics II (4)

AST 353 Photometry I (2)

AST 354 Photometry II (2)

AST 355 Astrometry (2)

AST 357 Spectroscopy (2)

AST 420 Stellar Astrophysics (3)

AST 421 Stellar Structure (3)

AST 430 Galactic Structure (3)

AST 431 Extragalactic Astronomy (3)

Required for Bachelor of Arts (BA) degree ONLY:

Language (8)

Required Minor: None.

### ASTRONOMY BS

Most professional astronomers hold a doctorate in astronomy or astrophysics; this major is designed to prepare students for graduate studies in these areas.

Required General Education (9 credits):

MATH 121 Calculus I (4)

PHYS 221 General Physics I (5)

Required Support Courses (Prerequisites, 20 credits):

MATH 122 Calculus II (4)

MATH 223 Calculus III (4)

MATH 321 Ordinary Differential Equations (4)

PHYS 222 General Physics II (5)

PHYS 435 Modern Physics I (3)

Required for Major (Core, 48 credits):

AST 201 Spherical Astronomy (2)

AST 215 Astronomy and Astrophysics I (4)

AST 225 Astronomy and Astrophysics II (4)

AST 353 Photometry I (2)

AST 354 Photometry II (2)

AST 355 Astrometry (2)

AST 357 Spectroscopy (2)

AST 420 Stellar Astrophysics (3)

AST 421 Stellar Structure (3)

AST 430 Galactic Structure (3)

AST 431 Extragalactic Astronomy (3)

PHYS 441 Mechanics (4)

PHYS 447 Electricity and Magnetism I (3)

PHYS 448 Electricity and Magnetism II (3)

PHYS 461 Quantum Mechanics (4)

COMS 272 FORTRAN Programming (4)

Required Minor: None.

### ASTRONOMY MINOR

Required General Education (9 credits):

MATH 121 Calculus I (4)

PHYS 221 General Physics I (5)

Required Support Courses (Prerequisites, 9 credits):

MATH 122 Calculus II (4)

PHYS 222 General Physics II (5)

Required for Minor (Core, 13 credits):

AST 125 Observational Astronomy (3)

AST 201 Spherical Astronomy (2)

AST 215 Astronomy and Astrophysics I (4)

AST 225 Astronomy and Astrophysics II (4)

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### POLICIES/INFORMATION

**GPA Policy.** Astronomy majors or minors must maintain a minimum 2.5 GPA in all coursework for their astronomy program, and in addition must earn a C or better for a course to apply to their major or minor. These standards apply to the courses required for the degree and their prerequisites. A minimum cumulative GPA of 2.0 is required for graduation. There are no prerequisite GPA requirements for internships.

Refer to the College regarding required advising for students on academic probation.

**P/N Grading Policy.** No more than one-fourth of the total undergraduate degree requirements may be earned in P/NC courses.

**Residency and Transfer Credit.** At least 30 hours of undergraduate credit must be earned at Minnesota State University, Mankato during the last two academic years.

Students majoring in astronomy have an advisor from their area of interest assigned to them. Questions and concerns pertaining to advising and the assignment of advisors can be answered by Angie B. Bomier, student relations coordinator, C125 Trafton Science Center, telephone 389-1521.

The astronomers operate two observatories on the southern edge of the campus: Standeford Observatory contains a 14-inch Schmidt-Cassegrain telescope, used for visual observations by general education students and other observatory visitors. Several other 8- to 13-inch telescopes are also available for instructional use by students in Astronomy 125. Andreas Observatory houses a 0.5-meter computer-controlled Cassegrain telescope. This instrument, which is equipped with photographic

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and electronic cameras and photometers, is used primarily for advanced instruction and faculty research. Standeford Observatory is open regularly for students and other visitors during the spring and the fall. Public viewing nights at Andreas Observatory are held occasionally during the year as weather permits.

### COURSE DESCRIPTIONS

#### AST 101 (3) Introduction to Astronomy

Broad survey of astronomy: the night sky, seasons, moon phases, eclipses, light, telescopes, stars, stellar evolution, galaxies, cosmology, the solar system. General Education Category 3.

F, S

GE-3

#### AST 102 (3) Introduction to the Planets

Survey of our solar system: the sun, planets, moons, asteroids, comets, and meteoroids; history of the discovery and exploration of the solar system. General Education Category 3.

F, S

GE-3

#### AST 104 (2) Introduction to Experimental Astronomy

Experiments in astronomy; astronomical observations; measurement, interpretation, and analysis of various types of astronomical data. General Education Category 3.

Pre or Coreq: AST 101 or 102 Variable

GE-3

#### AST 115 (2) Life in the Universe

The probability of extraterrestrial intelligent life; the chemical basis of life; planetary environments; habitable zones; the Drake equation; UFOs; space travel; interstellar communication; limits on technical civilizations. General Education Categories 2 and 3.

F, S

GE-2, 3

#### AST 125 (3) Observational Astronomy

Techniques for observing with naked eye, binoculars and small telescopes; constellation and star identification; use of star atlases and handbooks; observations of stars, binaries, clusters, nebulae, etc. Evening observing sessions required.

Pre: AST 101 or consent F

#### AST 201 (2) Spherical Astronomy

The celestial sphere; coordinate systems; sidereal and solar time; diurnal motion; precession; proper motion; refraction; aberration; parallax. Requires a background in trigonometry.

S

#### AST 215 (4) Astronomy and Astrophysics I

Celestial mechanics; gravitational and tidal forces; stellar motions and parallax; radiation and matter; magnitudes and stellar spectra; binary stars and stellar masses; stellar structure and evolution.

Pre: MATH 121 and PHYS 221 F

#### AST 225 (4) Astronomy and Astrophysics II

Stellar endpoints; close binary systems; variable stars; the Milky Way; normal galaxies; galactic evolution; active galaxies and quasars; cosmology.

Pre: AST 215, MATH 122, PHYS 222 S

#### AST 294 (1-6) Workshop

A short course devoted to a specific astronomical topic. May be repeated for credit on each new topic.

Variable

#### AST 351 (1) Telescope Operations

Telescope optics; operating the 0.5-meter telescope; pointing and guiding; preparation of observing lists and finder charts; operation of the telescope's ancillary equipment.

Pre: AST 201 and 215, Consent Variable

#### AST 353 (2) Photometry I

Photometric systems; observational techniques of point-source photometry; methods of data reduction; interpretation of data.

Pre: AST 215 ALT-F

#### AST 354 (2) Photometry II

Observations of extended sources; photometric calibration of extended sources; use of secondary standard stars.

Pre: AST 353 ALT-S

#### AST 355 (2) Astrometry

Reduction of digital images to determine positions, proper motions, and parallaxes of stars; analysis of errors.

Pre: AST 201 and 215 ALT-S

#### AST 357 (2) Spectroscopy

Line identification; radial velocity determinations; spectral classifications.

Pre: AST 225 ALT-F

#### AST 420 (3) Stellar Astrophysics

Blackbody radiation; radiative transfer; atomic structure; spectroscopic notation; excitation; ionization; absorption and emission coefficients; line profiles; analysis of stellar spectra.

Pre: AST 225 and PHYS 222 ALT-F

#### AST 421 (3) Stellar Structure

The gaseous state; degenerate matter; equations of stellar structure; polytropes; models of stellar interiors and atmospheres; stellar evolution; nucleosynthesis; stellar endpoints.

Pre: AST 420 ALT-S

#### AST 430 (3) Galactic Structure

Structure, kinematics, and dynamics of our galaxy.

Pre: AST 225, PHYS 222, MATH 223, and COMS 272 ALT-F

#### AST 431 (3) Extragalactic Astronomy

Normal galaxies; groups and clusters of galaxies; galaxy interactions and mergers; active galactic nuclei; large-scale structure; galaxy formation and evolution; cosmology.

Pre: AST 430 ALT-S

#### AST 488 (1-4) Seminar

May be repeated for credit on each new topic.

Pre: Consent Variable

#### AST 491 (1-6) In-Service

A course designed to upgrade the qualifications of persons on-the-job.

Variable

#### AST 493 (1-6) Undergraduate Research

Students will conduct supervised research in astronomy.

Pre: Consent Variable

#### AST 494 (1-6) Workshop

A short course devoted to a specific astronomical topic. May be repeated for credit on each new topic.

Variable

#### AST 495 (1-4) Selected Topics

A course in a particular area of astronomy not regularly offered. May be repeated for credit on each new topic.

Pre: Consent Variable

#### AST 497 (1-16) Internship

Provides a student the opportunity to gain expertise and experience in a special field under the supervision of a qualified person.

Pre: Consent Variable

AST 499 (1-8) Individual Study

Individual study under the guidance of an astronomy faculty member.

Pre: Consent F, S