Handbook for Astronomy Majors
September 2021
Department of Astronomy (www.astro.umass.edu)

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The College of Natural Sciences Advising Center:
220 Morrill II Science Center, 545-1969
www.cns.umass.edu/advising/cns-undergraduate-advising-center

The College of Natural Sciences Career and Professional Development Center:
215 Morrill III Science Center, 545-2238
www.cns.umass.edu/advising/cns-career-center

University Career Services:
511 Goodell Building 545-2224
www.umass.edu/careers/

University Counseling Services:
Middlesex House, 545-2337 or 545-0333
www.umass.edu/counseling/

Degree Requirements

University and College Requirements

To receive a bachelor's degree in astronomy, a student must meet the graduation requirement set by (1) the University, (2) the College of Natural Sciences and (3) the Department of Astronomy. The University requirements (total number of credits, number of credits in residence, GPA, general education requirements) are all explained in the Guide to Undergraduate Programs, available at www.umass.edu/ug_programguide/. We note that two of the general educations requirements (Junior Year Writing and Integrative Experience) are discipline specific and are also summarized under the Department requirements.

The College of Natural Science requirements for graduation are described on the College website at www.cns.umass.edu/academics/cns-degree-requirements/. For a BS degree the College of Natural Science requires 60 credits of coursework in departments within the college. For a BA degree there is a foreign language requirement (see College website for details).

Department Requirements

The Department offers both B.A. and B.S. degrees in astronomy. For the B.S. degree there are two tracks (Astrophysics track and the Space Science Track). If you are interested in adding an astronomy major or interesting in changing degree tracks, please consult one of our advisors and
they can provide the form needed to make this change. The requirements for these degrees and degree tracks are summarized below.

We note that the requirements for the BA degree has been recently revised. Therefore students declaring the major Summer 2018 or later have difference requirements that students declaring the major before Summer 2018.

**B.S. Astrophysics Track**

The Astrophysics track is recommended to those students who want to pursue a graduate degree in astrophysics and related fields.

**Astronomy Courses:**

- ASTRON 191A: First Year Seminar (1 credits, Fall semester only)
- ASTRON 228: Stars and Galaxies (3 credits, Spring semester only)
- ASTRON 301: Writing in Astronomy (3 credits, satisfies Junior year writing requirement – Fall semester only. Students with double majors should take the writing course offered by their primary major department.
- ASTRON 339: Astronomy in a Global Context (3 credits, satisfies the integrative experience requirement - Spring semester only) or PHYSICS 440. Students with double majors should take the integrative experience course offered by their primary major department.
- ASTRON 335: Modern Astrophysics (4 credits, Fall semester only)
- ASTRON 452: Astrophysics II – Galaxies (4 credits, Spring semester only)

One additional astronomy course (at least 3 credits) at the 300 level or higher (independent research, honors research or honors thesis do not satisfy this requirement). Recommendations:

- ASTRON 330: Topics in Astrophysics (3 credits.)
- ASTRON 337: Techniques of Optical and Infrared Astronomy (4 credits, fall semester)

Most faculty members in astronomy are engaged in basic research and undergraduate research opportunities are available through independent study, honor research and summer internships. Although not required, we encourage students to get involved in research.

**Physics Courses:**

- PHYSICS 181: Physics I – Mechanics (4 credits with lab, Fall semester only)
- PHYSICS 182: Physics II – Electricity and Magnetics (4 credits with lab, Spring semester only)
- PHYSICS 281: Computational Physics (3 credits, Fall or Spring semesters)
PHYSICS 282: Techniques of Theoretical Physics (3 credits., Spring semester only)

PHYSICS 284 (and associated lab PHYSIC 286): Modern Physics I (4 credits., Spring semester only)

PHYSICS 287 (and associated lab PHYSIC 289): Physics III – Waves and Thermodynamics (4 credits, Fall semester only)

PHYSICS 421: Mechanics I (3 credits, Fall semester only)

PHYSICS 422: Intermediate Electricity and Magnetism (3 credits., Spring semester only)

PHYSICS 423: Statistical Physics (3 credits., Spring semester only)

PHYSICS 424: Quantum Mechanics (3 credits, Fall semester only)

Math Courses:

MATH 131: Calculus I (4 credits., fall or spring semesters)

MATH 132: Calculus II (4 credits., fall or spring semesters)

MATH 233: Multivariate Calculus (3 credits., fall or spring semesters)

MATH 331: Ordinary Differential Equations for Scientists and Engineers (3 credits., fall or spring semesters)

Suggested Course Schedule:

Freshman Year:

Fall: ASTRON 191A, PHYSIC 181, MATH 131
Spring: ASTRON 228, PHYSIC 182, MATH 132

Sophomore Year:

Fall: PHYSIC 281, PHYSIC 287/289, MATH 233
Spring: PHYSIC 282, PHYSIC 284/286, MATH 331

Junior/Senior Years:

Fall: ASTRON 335, PHYSIC 421, PHYSIC 424, ASTRON 301
Spring: ASTRON 339, ASTRON 452, PHYSIC 422, PHYSIC 423,
Either Fall or Spring: one elective 300+ course
B.S. Space Science Track

The Space Science track is recommended for students pursuing an astronomy-related professional career after graduation.

Astronomy Courses:

ASTRON 191A: First Year Seminar (1 credits, Fall semester only)

ASTRON 228: Stars and Galaxies (3 credits, Spring semester only)

ASTRON 301: Writing in Astronomy (3 credits, satisfies Junior year writing requirement – Fall semester only. Students with double majors should take the writing course offered by their primary major department.

ASTRON 339: Astronomy in a Global Context (3 credits, satisfies the integrative experience requirement for those for which this is required - Spring semester only). Students with double majors should take the integrative experience course offered by their primary major department.

ASTRON 335: Modern Astrophysics (4 credits, Fall semester only)

Three additional courses (at least 3 credits each) all at the 200 level or higher and one of these three courses must be at the 300 level or higher (independent research, honors research or honors thesis do not satisfy this requirement). The 300+ level course could be in related fields such as Geoscience or Physics, however need Department Advisor Approval. Some options for 200+ and 300+ level astronomy courses:

   ASTRON 220: Special Topics in Astronomy (3 credits)
   ASTRON 223: Planetary Science (3 credits)
   ASTRON 330: Topics in Astrophysics (3 credits.)
   ASTRON 337: Techniques of Optical and Infrared Astronomy (4 credits, fall semester only)

Most faculty members in astronomy are engaged in basic research and undergraduate research opportunities are available through independent study, honor research and summer internships. Although not required, we encourage students to get involved in research.

Physics Courses:

PHYSIC 181 Physics I – Mechanics (4 credits with lab, Fall semester only) or PHYSICS 151: General Physics I (4 credits, fall or spring semesters)

PHYSICS 182: Physics II – Electricity and Magnetics (4 credits with lab, Spring semester only) or PHYSICS 152: General Physics II (4 credits, fall or spring semesters)

PHYSICS 281: Computational Physics (3 credits, Fall or Spring semester)
PHYSICS 284 (and associated lab PHYSIC 286): Modern Physics I (4 credits., Spring semester only)

PHYSICS 287 (and associated lab PHYSIC 289): Physics III – Waves and Thermodynamics (4 credits, Fall semester only)

One additional elective Physics course (at least 3 credits) at the 400+ level

**Math Courses:**

MATH 131: Calculus I (4 credits., fall or spring semesters)

MATH 132: Calculus II (4 credits., fall or spring semesters)

MATH 233: Multivariate Calculus (3 credits., fall or spring semesters)

**Concentration Requirement:**

Three courses (each at least 3 credits) in a related field. The courses used to satisfy the concentration requirement cannot be used to satisfy any of the requirements listed above. Students should consult with their Department Advisor to formulate a plan. Each student will need to submit a 1 page proposal outlining the 3 courses and the rational behind them. This proposal will need to approved a Department Advisor (the advisor should enter the approved plan in the SPIRE notes).

**Examples of Concentration Programs**

1. Astrobiology
   a. Bio 151, 152+153(lab), 285 (cell and molecular biology)

2. Astro-Chemistry
   a. Chem 111, 112, and 261

3. Astronomy and Math
   a. Math 235, 331, and 551
   b. Math 235, 331, and Statistics 515

4. Astronomy and Geoscience
   a. Geology 311 (Mineralogy), 321 (Petrology), and 445 (Structural Geology): These courses focus on the chemical and physical properties or minerals, rocks and the larger structures rock make up like tectonic plates. These courses are vital for
understanding the formation, dynamics, and possible environments of, not only Earth, but also all bodies composed on similar materials.

b. Geology 321 (Petrology), 441 (Structural Geology), 445 (Sedimentology): These classes will provide knowledge that is crucial to understanding the geologic history and evolution of planetary bodies, and by extension the history and possible future for our home planet

c. Geology 201 (History of the Earth), Geology 231 (Geology Field Methods), and Geology 354 (Climatology)

d. Geology 201 (History of the Earth), Geology 231 (Geology Field Methods), and Geology 311 (Mineralogy)

5. Astronomy and Computer Science

a. Computer Science 187 (Programming with Data Structures), Computer Science 250 (Introduction to Computation), and Computer Science 240 (Reasoning under Uncertainty)

6. Astronomy and Mechanical Engineering

a. MIE 230 (Thermodynamics), MIE 340 (Fluid Mechanics), MIE 354 (Heat Transfer)

b. MIE 211 (Strengths of Materials), MIE 313 (Design of Mechanical Components), and MIE 354 (Heat Transfer)

Suggested Course Schedule:

Freshman Year:

Fall: ASTRON 191A, PHYSICS 151/181, MATH 131
Spring: ASTRON 228, PHYSICS 152/182, MATH 132

Sophomore Year:

PHYSICS 281 (fall), PHYSICS 287/289 (fall), PHYSICS 284/286 (spring semester). MATH 233 (fall or spring semester), and two additional 220+ level astronomy courses (fall or spring semester), concentration courses

Junior/Senior Years:
ASTRON 301 (fall semester), ASTRON 335 (fall semester), ASTRON 339 (spring semester), one additional 400+ level physics courses (fall or spring) and one additional 300+ level astronomy course (fall or spring), concentration courses

**B.A. Degree**

The B.A. degree is designed for students seeking careers in teaching, museum work, science writing, pre-med, etc.

**Astronomy Courses:**

ASTRON 191A: First Year Seminar (1 credits, Fall semester only)

ASTRON 228: Stars and Galaxies (3 credits, Spring semester only)

ASTRON 301: Writing in Astronomy (3 credits, satisfies Junior year writing requirement – Spring semester only. Students with double majors should take the writing course offered by their primary major department.

ASTRON 339: Astronomy in a Global Context (3 credits, satisfies the Integrative Experience requirement for those for which this is required - Spring semester only). Students with double majors should take the writing course offered by their primary major department.

ASTRON 335: Modern Astrophysics (4 credits, Fall semester only)

Three additional astronomy courses (at least 3 credits each) and one of these three additional course must be at the 300 level or higher (independent research, honors research or honors thesis do not satisfy this requirement). The 300+ level course can also be in closely related subjects such as Geoscience or Physics, but need approval by Department Advisor. Some options for 200+ and 300+ level astronomy courses:

- ASTRON 220: Special Topics in Astronomy (3 credits)
- ASTRON 223: Planetary Science (3 credits, usually in spring semester)
- ASTRON 330: Topics in Astrophysics (3 credits.)
- ASTRON 337: Techniques of Optical and Infrared Astronomy (4 credits, fall semester)

**Physics Courses:**

PHYSIC 181 Physics I – Mechanics (4 credits with lab, Fall semester only) or PHYSICS 151: General Physics I (4 credits, fall or spring semesters)

PHYSICS 182: Physics II – Electricity and Magnetics (4 credits with lab, Spring semester only) or PHYSICS 152: General Physics II (4 credits, fall or spring semesters)

PHYSICS 281: Computational Physics (3 credits, Fall semester only)
PHYSICS 284 (and associated lab PHYSIC 286): Modern Physics I (4 credits., Spring semester only)

PHYSICS 287 (and associated lab PHYSIC 289): Physics III – Waves and Thermodynamics (4 credits, Fall semester only)

Math Courses:
MATH 131: Calculus I (4 credits., fall or spring semesters)
MATH 132: Calculus II (4 credits., fall or spring semesters)
MATH 233: Multivariate Calculus (3 credits., fall or spring semesters)

Suggested Course Schedule:

Freshman Year:

Fall: ASTRON 191A, PHYSICS 181 or 151, MATH 131
Spring: PHYSICS 182 or 152, MATH 132, ASTRON 228

Sophomore Year:

Astronomy elective at 200+ level, PHYSICS 281, PHYSICS 284/286, PHYSICS 287/289, MATH 233

Junior/Senior Years:

ASTRON 301 (fall semester), ASTRON 335 (fall semester), ASTRON 339 (spring semester), additional astronomy elective course to complete requirements

Minor in Astronomy

Requirements for a Minor in astronomy consists of taking ASTRON 228 and four additional courses at the 200+ level.

Honors in Astronomy

Departmental Honors is an Advanced Scholarship track of Commonwealth Honors College. Students may complete Departmental Honors as part of the full Commonwealth Honors College
curriculum, which includes Honors General Studies, or they may complete Departmental Honors alone.

Students who are not already members of Commonwealth Honors College must apply to Departmental Honors via the online application using the following link: [http:www.umass.edu/honors/admissions/apply](http:www.umass.edu/honors/admissions/apply). Admission to Departmental Honors will be at the discretion of the Honors Program Director. Minimally, to be eligible to apply for Departmental Honors, students must have (1) an overall GPA of 3.40 or higher earned after one fulltime semester of UMass Amherst coursework, (2) the ability to complete the Departmental Honors-Track requirements, and (3) the ability to complete the Commonwealth Honors College residency requirement of 45-graded credits (not pass/fail) earned at UMass Amherst (not transferred).

The Astronomy requirements for the completion of Departmental Honors are the following:

- One honors course chosen from ASTRON 335 or 337
- One additional astronomy honors course 300-level or higher
- Honors Thesis or Project (students will need to sign up for ASTRON 499Y and 499T and file a proposal with the Commonwealth Honors College)

For more information about Departmental Honors in Astronomy, speak with our Honors Program Director Professor Min Yun.

**Five College Interchange**

The undergraduate curriculum is shared among the Five Colleges, therefore you may want or need to take an astronomy course at one of the other campuses. Enrollment for these off-campus classes are handled by the Five College Interchange office located in 613 Goodell.

**Step by Step Instructions**

- Identify course(s) from [Five College Course Catalog](https://www.fivecolleges.edu/courses/). Do not request more than 8 credits at any one institution.
- Log into Spire
- On the top bar, click on the MAIN menu.
- Scroll down until you see ENROLLMENT, click on that.
- Click on FIVE COLLEGE ENROLLMENT
- The Five College Registration page appears, read and click through to the Request Form.
- Fill in all the information about the course.
- Click Submit. **YOU ARE NOT DONE**
- You will see a Course Registration Receipt. Save the Registration Receipt as a PDF not as a picture or screen shot.
- If the Registration Receipt says you must get instructor permission (always the case during add-drop at the beginning of the semester, not always the case during pre-registration) email the instructor, attaching the receipt for a signature.
• If the instructor cannot sign the actual form, an email verifying approval to enroll in the class is sufficient. YOU ARE NOT DONE
• Email the PDF Registration Receipt and instructor approval to 5collreg@umass.edu. If the instructor approval is an email, please submit it with the PDF Registration Receipt in the same email.
• The Five College Interchange office will process the Registration Receipt if there are enough credits available on your schedule to add the course. It is your responsibility to ensure you have enough credits available.
• You can check the status of the Registration on the Spire page in the Five College Enrollment
• Please send one email for each course, attaching the receipt and if required the instructor permission.

For additional information go to the following website: http://www.umass.edu/fivecollegeinterchange/

Independent Study

Students may wish to concentrate on topics or research outside to the classroom. Opportunities for this type of investigation exist through the Independent Study courses (ASTRON 196, 296, 396 and 496). These courses are arranged on a semester basis between a student and a professor. Depending on the type of activity, these classes generally range from 1 to 3 credits.

There are also many summer intern programs in astronomy. A list of these Research Experiences for Undergraduates can be found on the American Astronomical Society's website: http://aas.org/learn/internships-scholarships.

In addition to the REU programs funded by the National Science Foundation and listed on the AAS website, the Five College Astronomy Department runs a summer research intern program each summer for astronomy students within the Five Colleges. Details of this program can be found at: http://www.astro.umass.edu/academics/five-college-astronomy-undergraduate-internship-program.edu. We encourage students to take advantage of these intern programs.

Scholarships, Internships, and Career Information

The College of Natural Sciences is your primary source of general scholarships. You have access to additional general scholarships if you are a member of the Commonwealth Honors College. For the Internships and Career Information/Advice, I strongly recommend starting on the AAS Career and AstroBetter pages. Most of the national and international opportunities are found there.