

Astronomy

The astronomy department administers the major in astronomy and offers a collaborative undergraduate major in astronomy through the Five College Department of Astronomy (FCAD). Faculty: Professors Dyar (Mount Holyoke *chair*); Visiting Assistant Professors Fassett, Levine; Director of the Observatory Stage; Five College Faculty Calzetti, Edwards, Erickson, Fardal, Giavalisco, Greenstein, Gutermuth, Hameed, Hanner, Heyer, Katz, Lowenthal, Mo, Narayanan, Pope, Schloerb, Schneider, Snell (Five College *chair*), Tripp, Wang, Weinberg, Wilson, Young, Yun.

Astronomical facilities at all five institutions are available for student use. The Williston Observatory at Mount Holyoke includes a historic Clark 8" telescope. The McConnell Rooftop Observatory at Smith College includes two computer-controlled Schmidt Cassegrain telescopes, and the Amherst Observatory has a Clark 18" refractor. Students may obtain research and thesis data here or as guest observers at other observatories.

Contact Persons

Cynthia Morrell, *senior administrative assistant*

M. Darby Dyar, *chair*

Modern astronomy is concerned with understanding the nature of the universe and the various structures—galaxies, stars, planets, atoms—within it. We are interested not only in describing these things, but in understanding how they are formed and how they change, and, ultimately, in reconstructing the history of the universe.

This understanding is always based upon the same set of theories and practices—physics, chemistry, biology, materials science, mathematics, computer science—that we use to understand the earth and its immediate surroundings. Thus, all students are strongly encouraged to base their study of the universe upon a firm grounding in one of these disciplines.

All 100-level courses are taught by Mount Holyoke faculty and staff. Courses at the 200 level and above are staffed collectively by faculty in the Five College Department (as listed above); many of them will be offered off campus. Students are urged to consult the department to assist in planning a program of study that takes advantage of the rich variety of course opportunities. Through advising, the exact program is always tailored to the student's particular strengths, interests, and plans.

Requirements for the Astronomy Major

The astronomy major is designed to provide a good foundation in modern science with a focus on astronomy. Taken alone, it is suited for students who wish to apply scientific training in a broad general context. If coupled with additional course work in related fields, the astronomy major or minor provides the foundation to pursue a career as a professional astronomer or planetary scientist. Thus, advanced courses in physics, mathematics, geology, biology, and/or chemistry, as well as a facility in computer programming, are strongly encouraged.

Students should note that completion of this major will likely require them to travel to other institutions within the Five Colleges.

The major in astronomy is based on completion of Mathematics 100/101 and 202 and Physics 115 as prerequisites for the courses.

Credits

- A minimum of 32 credits, including the following or their approved equivalents:
- AST 100/101 (Survey of the Universe) or AST 110 (Introduction to Astronomy) (4 credits)
- Physics 216 (Electromagnetism) (4 credits)
- Two astronomy courses at the 200 level (8 credits) from the offerings of the Five College Astronomy department

- One astronomy course at the 300 level (4 credits) from the offerings of the Five College Astronomy department
- Three additional courses, of which two must be at the 300 level, in astronomy or a related field such as mathematics, physics, geology, biology, computer science, or the history or philosophy of science (12 credits)

Students planning graduate study should generally regard this as a minimum program and include additional 300-level work. Advanced course work in physics and mathematics is especially encouraged for students wishing to pursue graduate studies in astronomy.

Requirements for the Astronomy Minor

The goal of an astronomy minor is to provide a practical introduction to modern astronomy. If combined with a major in another science or mathematics-related field, such as geology, chemistry, or computer science, it can provide a versatile scientific background that prepares a student for future work as a scientist or technical specialist. Alternatively, the minor may be combined with a major in a nonscientific field, such as history, philosophy, or education, for students who wish to apply their astronomical backgrounds in a broader context that could include history of science, scientific writing or editing, or science education.

Credits

- A minimum of 16 credits above the 100 level, including:
- One 300-level astronomy, physics, or geology course
- Three additional 200- or 300-level courses in astronomy

Five College Course Offerings

Astronomy students will probably take multiple courses off-campus as part of the integrated curriculum of the Five College Astronomy Department. In addition to the courses listed in the Mount Holyoke course catalogue, the following courses are offered at

other institutions. Students should consult these course listings at the home institution where they are offered. Enrollment is done through the Five College Interchange.

220f Special Topics in Astronomy

Intermediate-level classes designed to introduce special topics in astronomy such as comets and asteroids, meteorites, and science and public policy, generally without prerequisites. Special offerings vary from year to year. See listings at individual institutions for more information.

*224s Stars

The basic observational properties of stars will be explored in an experimental format relying on both telescopic observations and computer programming exercises. No previous computer programming experience is required.

S. Edwards (offered at Smith College). Prereq. Physics 115, Mathematics 202 and one astronomy course; alternates with Astronomy 225.

225s Galaxies and Dark Matter

The role of gravity in determining the mass of the universe will be explored in an interactive format making extensive use of computer simulations and independent projects.

S. Edwards (offered at Smith College). Prereq. Physics 115, Mathematics 202 and one astronomy course; alternates with Astronomy 224.

*226f Cosmology

The course introduces cosmological models and the relationship between models and observable parameters. Topics in current astronomy that bear upon cosmological problems will be covered, including background electromagnetic radiation, nucleosynthesis, dating methods, determinations of the mean density of the universe and the Hubble constant, and tests of gravitational theories. We will discuss questions concerning the foundations of cosmology and its future as a science.

G. Greenstein (offered at Amherst College). Prereq. Mathematics 101 and a physical science course

228s Astrophysics I: Stars and Galaxies

This course is a calculus-based introduction to the properties, structure, formation, and evolution of stars and galaxies. The laws of gravity, thermal physics, and atomic physics provide a basis for understanding observed properties of stars, interstellar gas, and dust. We apply these concepts to develop an understanding of stellar atmospheres, interiors, and evolution, the interstellar medium, and the Milky Way and other galaxies.

Offered in alternate years at Hampshire, Smith, and Mount Holyoke Colleges. Prereq. Physics 115, Physics 216 or concurrent enrollment, and Math 202

330fs Seminar: Topics in Astrophysics

In-class discussions will be used to formulate a set of problems, each designed to illuminate a significant aspect of the topic at hand. The problems will be difficult and broad in scope: their solutions, worked out individually and in class discussions, will constitute the real work of the course. Student will gain experience in both oral and written presentation. Topics vary from year to year. See listings at individual institutions for more information.

335f Astrophysics II: Stellar Structure

How do astronomers determine the nature and extent of the universe? Centering around the theme of the “Cosmic Distance Ladder,” we explore how astrophysics has expanded our comprehension to encompass the entire universe. Topics include: the size of the solar system; parallax and spectroscopic distances of stars; star counts and the structure of our galaxy; Cepheid variables and the distances of galaxies; the Hubble Law and large-scale structure in the universe; quasars and the Lyman-Alpha Forest.

Offered at the University of Massachusetts. Prereq. Astronomy 228 or instructor approval.

***337s Observational Techniques in Optical and Infrared Astronomy**

This course is an introduction to the techniques of gathering and analyzing astronomical data, particularly in the optical and infrared. Telescope design and optics will be discussed, along with instrumentation for imaging, photometry, and spectroscopy. Topics will include astronomical detectors, computer graphics and image processing, error

analysis and curve fitting, and data analysis and astrophysical interpretation, with an emphasis on globular clusters.

J. Lowenthal (offered at Smith College). Prereq. at least one 200-level astronomy course.

352s Astrophysics III: Galaxies and the Universe

Advanced course covering physical processes in the gaseous interstellar medium, including photoionization in HII regions and planetary nebulae, shocks in supernova remnants and stellar jets, and energy balance in molecular clouds. Dynamics of stellar systems, star clusters, and the viral theorem will also be discussed, along with galaxy rotation and the presence of dark matter in the universe, as well as spiral density waves. The course concludes with quasars and active galactic nuclei, synchrotron radiation, accretion disks, and supermassive black holes.

Offered at the University of Massachusetts.

Prereq. Astronomy 335 or two physics courses at the 200 or 300 level.

Mount Holyoke Course Offerings**100fs Survey of the Universe**

Discover how the forces of nature shape our understanding of the cosmos. Explore the origin, structure, and evolution of the earth, moons and planets, comets and asteroids, the sun and other stars, star clusters, the Milky Way and other galaxies, clusters of galaxies, and the universe as a whole.

Meets Science and Math II-C requirement

J. Levine, D. Dyar

The lecture for this course meets at the same time as the lecture for ASTR-101 but this course does not have a lab.; 4 credits

101fs Survey of the Universe with Lab

Discover how the forces of nature shape our understanding of the cosmos. Explore the origin, structure, and evolution of the earth, moons and planets, comets and asteroids, the sun and other stars, star clusters, the Milky Way and other galaxies, clusters of galaxies, and the universe as a whole. In lab, learn the constellations and how to use the telescopes. Use them to observe celestial objects, including the moon, the sun, the planets, nebulae, and galaxies. Learn celestial coordinate and

timekeeping systems. Find out how telescopes work.

Meets Science and Math II-B requirement

J. Levine, M. Stage, D. Dyar

2 meetings (75 minutes) and 1 lab (3 hours).

Designed for non-science majors. The lecture for this course meets at the same time as the lecture for AST 100. FY only, though others will be able to register during Add/Drop if spaces remain available.; 4 credits

110fs Introduction to Astronomy

A comprehensive introduction to the study of modern astronomy that explores the celestial bodies that inhabit the universe—planets, stars, and galaxies- and examines the universe itself—its origin, structure, and ultimate destiny.

Meets Science and Math II-C requirement

J. Levine, D. Dyar

Prereq. Mathematics 100 or 101 or the equivalent; The lecture for this course meets at the same time as the lecture for ASTR-100 and 101. Students in this course (110) must attend a weekly 4th hour section.; 4 credits

223s Planetary Science

This intermediate-level course covers fundamentals of spectroscopy, remote sensing, and planetary surfaces. Discussions will include interiors, atmospheres, compositions, origins, and evolution of terrestrial planets; satellites, asteroids, comets, and planetary rings.

Meets Science and Math II-C requirement

C. Fassett, D. Dyar

Prereq. Mathematics 100/101 and one semester of a physical science course; 4 credits

***228s Astrophysics I: Stars and Galaxies**

A calculus-based introduction to the properties, structure, formation, and evolution of stars and galaxies. The laws of gravity, thermal physics, and atomic physics provide a basis for understanding observed properties of stars, interstellar gas, and dust. We apply these concepts to develop an understanding of stellar atmospheres, interiors, and evolution, the interstellar medium, and the Milky Way and other galaxies.

Does not meet a distribution requirement

J. Levine

Prereq. Physics 115 and Math 202; Physics 216 and Math 203 strongly suggested; 4 credits

295fs Independent Study

Does not meet a distribution requirement

The department

Prereq. soph; 1-4 credits

***330f Seminar: Topics in Astrophysics**

Fall 2011

***330f(1) Mars**

Exploration of several unresolved questions about the Red Planet, such as 1) Where was the water on Mars and where did it go? How well will future missions answer this question? 2) How has the Martian atmosphere evolved over time? 3) What rock types are present on the Martian surface based on meteorite studies vs. direct observation? 4) How can geomorphic features of Mars best be interpreted, and what do they tell us about the evolution of the planet? and 5) Was there life on Mars at any time? Is there life on Mars at present, and if so, where? An interactive seminar with students and faculty reading current papers from the literature as well as daily reports from current mission Web sites.

D. Dyar

Prereq. any intermediate-level astronomy or geology course; Astronomy 223 recommended; 4 credits

***330f(2) Moon**

This course will survey the past, present, and future of lunar exploration and science. We will focus on the evolution of the Moon as a paradigm for terrestrial planets, with specific units on interiors, heat flow, thermal evolution, magnetism, volcanism, volatiles, impacts, crustal composition and mineralogy, regoliths, and spectroscopy of its surface. This is a discussion-based, interactive seminar with students and faculty reading current papers from the literature.

The department

Prereq. any intermediate-level astronomy or geology course; Astronomy 223 recommended; 4 credits

330f(3) Astrobiology

(Writing-intensive course) Are we alone in the universe? The essence of that question has likely been a source of inspiration since the dawn of humanity. We will look at the history of extraterrestrial debate and analyze

the transdisciplinary science behind astrobiology. We will investigate the properties of life as we know it and extrapolate their properties to consider the potential for simple life forms to exist on Mars and elsewhere in our solar system, to the possibility of intelligent life on habitable planets near distant stars, and finally the implications of extraterrestrial life to life on Earth. Assessments will include critical reading and writing about scientific literature on this topic.

D. Dyar

Prereq. Permission of instructor; offered at Hampshire College fall 2011; 4 credits

395fs Independent Study

Does not meet a distribution requirement

The department

Prereq. jr, sr, permission of department; 1-8 credits