ASTRONOMY

Undergraduate Program Information

The department offers an undergraduate astronomy minor degree, which requires 18-20 credits. The department does not offer a BS degree but encourages interested students to enroll in the physics program as a first step toward a career in astronomy. Our 100- and 300-level courses meet various university general education requirements. All students are invited to share with us this exciting area of study, through our basic and advanced undergraduate courses

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¹ Other courses at the 300 and 400-levels are offered on an occasional basis. Consult the "Course Descriptions" section in this catalog.
² ASTR 405 Astronomy and Astrophysics I, ASTR 406 Stellar Dynamics and Hydrodynamics and ASTR 435 Observational Techniques I are cross-listed with graduate classes and require special permission.

Graduate Program Information

The Department of Astronomy offers graduate work leading to the Doctor of Philosophy and Master of Science degrees. To be admitted as a regular student to the NMSU Graduate School as a major in astronomy, a student must present a suitable undergraduate background with emphasis (12-16 credits) on junior-senior level physics, and mathematics. The prospective student is also required to take aptitude and physics (or approved specialized field) sections of the Graduate Record Examination (GRE).

Information on assistantships and fellowships in teaching and research can be obtained from the department.

Each entering graduate student will be assigned a committee that will guide the student in choice of courses, suggest training needed to remedy deficiencies and determine specific degree requirements in accord with the student’s needs and objectives, and in agreement with departmental policies. The program requires 33 traditional course credit hours (11 classes), 4 seminar class credit hours, plus research in astronomy. Each student must demonstrate no later than during the second year sufficient academic and research ability to qualify for continuation in doctoral studies.

It is possible, through arrangement with the Department of Physics, to obtain a Master of Science degree in physics during progress toward the Ph.D. in astronomy. See the Department of Physics (http://catalogs.nmsu.edu/nmsu/arts-sciences/physics) section in this catalog for details of that program.

The MS degree in astronomy is closely connected with the astronomy Ph.D. program, and questions concerning requirements should be directed to the department.

Qualifying, Comprehensive and Final examinations are described elsewhere in this catalog. Questions concerning styles of the examinations should be directed to the department head.

The department has access to several different observing facilities. NMSU operates the Apache Point Observatory on behalf of the Astrophysical Research Corporation and the observatory is home to several telescopes:

- the ARC 3.5m telescope,
- a 1m telescope fully owned by NMSU
- the ARCSAT 0.5m telescope, and
- the Sloan Digital Sky Survey (SDSS) 2.5m telescope.

The Department is a full partner in the SDSS project. The Department also operates a 24-in telescope on Tortugas Mountain, near the NMSU campus.

The department is home to NASA’s Planetary Data System’s Planetary Atmosphere Node, where solar system exploration data are archived.

Degrees for the Department

Astronomy - Master of Science (http://catalogs.nmsu.edu/nmsu/arts-sciences/astronomy/astronomy-master-science)

Astronomy - Doctor of Philosophy (http://catalogs.nmsu.edu/nmsu/arts-sciences/astronomy/astronomy-doctor-philosophy)

Minors for the Department

Astronomy - Undergraduate Minor (http://catalogs.nmsu.edu/nmsu/arts-sciences/astronomy/astronomy-undergraduate-minor)

Professor, Jon Holtzman, Department Head

Professors Chanover, Churchill, Murphy, Klypin, Walterbos; Associate Professors Jackiewicz, McAteer; Assistant Professors Finlator, Prescott; College Professors Beebe, Webber; Observatory Specialist Harrison

J. Holtzman, Department Head, Ph.D. (California- Santa Cruz) – stellar populations in galaxies; R. F. Beebe, Ph.D. (Indiana-Bloomington) – planetary astronomy and stellar spectra; N. Chanover, Ph.D. (New Mexico State) – planetary astronomy; C. Churchill, Ph.D. (California-Santa Cruz) – galaxies and intergalactic medium; K. Finlator, Ph.D. (University of Arizona) – Galaxy Evolution, the Intergalactic Medium, Cosmological Reionization; Harrison, Ph.D. (Minnesota) – cataclysmic variables and gamma-ray burst sources; J. Jackiewicz, Ph.D. (Boston College) – Helioseismology, theoretical condensed matter physics; A. Klypin, Ph.D. (Moscow) – cosmology; R. T. J. McAteer, Ph.D. (Queen’s University, Belfast) – solar physics, Sun-Earth connection; J. Murphy, Ph.D. (U. Washington) – planetary atmospheres and exploration; M. Prescott, Ph.D. (University of Arizona) – Lyman-alpha nebulae, kinematics of gas within cosmic web; R. Walterbos, Ph.D. (Leiden) – interstellar medium, star formation, and structure and evolution of galaxies; W. Webber, Ph.D. (Iowa) – high energy astrophysics

catalogs.nmsu.edu/nmsu/arts-sciences/physics
Astronomy

ASTR 105G. The Planets
4 Credits (3+2P)
Comparative study of the planets, moons, comets, and asteroids which comprise the solar system. Emphasis on geological and physical processes which shape the surfaces and atmospheres of the planets. Laboratory exercises include analysis of images returned by spacecraft. Intended for non-science majors, but some basic math required. This lecture/lab course satisfies the New Mexico Common Core Area III: Lab Sciences requirement.

ASTR 110G. Introduction to Astronomy
4 Credits (3+2P)
A survey of the universe. Observations, theories, and methods of modern astronomy. Topics include planets, stars and stellar systems, black holes and neutron stars, supernovas and gaseous nebulae, galaxies and quasars, and cosmology. Emphasis on physical principles involving gravity, light and optics (telescopes). Generally non-mathematical. Laboratory involves use of the campus observatory and exercises designed to experimentally illustrate principles of astronomy. This lecture/lab course satisfies the New Mexico Common Core Area III: Lab Sciences requirement.

ASTR 199. Introduction to Astronomy Lab, Special
1 Credit
This lab-only listing exists only for students who may have transferred to NMSU having taken a lecture-only introductory astronomy class, to allow them to complete the lab requirement to fulfill the general education requirement. Consent of Instructor required. Restricted to Las Cruces campus only.
Prerequisite(s): Must have passed Introduction to Astronomy lecture-only (e.g.

ASTR 301V. Revolutionary Ideas in Astronomy
3 Credits
Examines recent fundamental scientific revolutions that have shaped our view of Earth and the universe. Topics in astronomy range from exoplanets to black holes to dark energy and raise questions about the very nature of how we use the scientific method to see the unseen, and how this shapes science research today.
Prerequisite(s): Any general education science course.

ASTR 305V. The Search for Life in the Universe
3 Credits
Use of information from several of the sciences to explore the likelihood that life exists elsewhere in the universe. Subjects include an overview of historical ideas about the possibility of life elsewhere in the universe, the chemistry and biology of life on Earth, recent explorations for life within our solar system, and current search strategies for life in the universe and their scientific basis.

ASTR 308V. Into the Final Frontier
3 Credits
Exploration of space: a brief review of the history of space flight, the Apollo program, joint U.S.-Soviet space missions, and unstaffed exploration of the planets. Emphasis on knowledge gained through these efforts. Includes new space initiatives. Same as HON 308V.

ASTR 330V. Planetary Exploration
3 Credits
A current planetary exploration mission is studied within the context of the solar system. The data acquired and principles involved in executing the mission, as well as political and economic implications of planetary exploration, are examined. Same as HON 330V. Main campus only

ASTR 400. Undergraduate Research
1-3 Credits
Supervised individual study or research. May be repeated for a maximum of 6 credits.
Prerequisite: consent of instructor.

ASTR 401. Topics in Modern Astrophysics
3 Credits
This course is designed for students interested in astrophysics who have some background in math and physics and want to learn about basic astrophysical concepts such as orbital mechanics, light, and radiative processes and transfer. These concepts will be applied to the discussion of exciting modern topics involving planets, exoplanets, stars, galaxies, and/or cosmology, with topical emphasis determined by the instructor.
Prerequisite(s): MATH 192G and (PHYS 213 or PHYS 215G).

ASTR 402. Introduction to Astronomical Observations and Techniques
3 Credits
Designed for students interested in astrophysics who have some background in math and astronomy and want to learn about techniques for obtaining and analyzing astronomical data. This course will review the properties of light and discuss the process of experimental design. The course will describe basic observational tools such as telescopes and detectors. It will discuss how data is obtained, and how features of the detector and the Earth's atmosphere can be corrected for. Some topics in basic astronomical data analysis will be discussed, with topical emphasis determined by the instructor. Some simple data analysis projects will be assigned.
Prerequisite(s): MATH 191G and (PHYS 214 or PHYS 216G) and (ASTR 105, ASTR 110, or ASTR 401).

ASTR 405. Astronomy and Astrophysics I
3 Credits
Application of physical principles to problems in modern astronomy. Emphasis on radiation mechanisms and radiation transfer in astronomical systems. No S/U grading. Same as ASTR 505 with less advanced work.
Prerequisite: consent of instructor.

ASTR 406. Stellar Dynamics and Hydrodynamics
3 Credits
Undergraduate cross-listing of graduate class on basic stellar dynamics and principles of hydrodynamics. Consent of Instructor required.
Prerequisite(s): Consent of instructor.

ASTR 435. Observational Techniques I
3 Credits
Up-to-date introduction to modern observational astronomy. Includes computers, data analysis, optical telescopes, optical and infrared photometry, image processing, and detection. No S/U grading. Same as ASTR 535 with less advanced work.
Prerequisite: consent of instructor.

ASTR 500. Seminar
1 Credit
Organized group study treating selected topics.

ASTR 505. Astronomy and Astrophysics I (f)
3 Credits
Application of physical principles to problems in modern astronomy. Emphasis will be on radiation mechanisms and radiation transfer in astronomical systems.
Prerequisite: consent of instructor.
ASTR 506. Stellar Dynamics and Hydrodynamics
3 Credits
Graduate level course on basic stellar dynamics and fundamentals of hydrodynamics.

ASTR 535. Observational Techniques I (f)
3 Credits
Up-to-date introduction to modern observational astronomy in a two-semester sequence. Topics include: introduction to computers, error analysis in data, the different types of optical telescopes, and optical and infrared photometry, image processing, and detectors.

ASTR 536. Observational Techniques in Astronomy II (s)
3 Credits
Sequel to ASTR 535. The second half of the course emphasizes observational techniques in spectroscopy, radio astronomy, and high energy astrophysics.
Prerequisite: ASTR 535.

ASTR 545. Stellar Spectroscopy
3 Credits
This course covers the physics of stellar atmospheres with emphasis on using spectra as a diagnostic tool for understanding the properties of stars. Topics include spectral classification, radiative transfer, gas equilibrium physics, line and continuum opacities, adiabatic and superadiabatic convection, and extraction of observed quantities from spectra for deducing physical conditions of the source.

ASTR 555. Galaxies I
3 Credits
Fundamentals of the properties of galaxies and the components that they are made of stars and stellar populations, gas and dust, central black holes, and dark matter. Introduction to basic concepts of galaxy formation.

ASTR 565. Stellar Interiors
3 Credits
Internal constitutions of stars, computation of stellar models, and stellar evolution.

ASTR 575. Computational Astrophysics
3 Credits
Scientific programming for astronomical applications. Explore key algorithms and standard techniques for astronomical data analysis. Topics may include pointers, data structures, dynamic memory allocation, least squares fitting, grid and iterative search methods, LCG random number generators, Monte Carlo simulations, numerical integration, and astronomical image and spectrum manipulation. Applications to real astronomical datasets are emphasized.

ASTR 598. Special Research Programs
1-6 Credits
Individual investigations, either analytical or experimental.

ASTR 599. Master's Thesis
15 Credits
Master's level research in astrophysics or observational astronomy.

ASTR 600. Pre-dissertation Research
1-15 Credits
Research.

ASTR 605. Interstellar Medium
3 Credits
Problems associated with gas and dust in the galaxy and with diffuse and planetary nebulae.

ASTR 610. Radio Astronomy
3 Credits
Techniques and observations stressing the operational approach to measurement and how the observations are intimately interwoven throughout modern astrophysics.

ASTR 616. Galaxies II
3 Credits
Advanced topics in galaxies. Includes a detailed description and understanding of the Milky Way and topics in galaxy formation and evolution.

ASTR 620. Planetary Science I
3 Credits
Evaluation and analysis of observational data on solar system objects to determine their nature and physical conditions, with emphasis upon atmospheres (composition, structure, thermodynamics, evolution, etc.)

ASTR 621. Planetary Science II
3 Credits
The physical processes involved in planetary system formation are addressed. Specific foci include molecular cloud collapse, disk processes, and competing theories of planet formation within disks. Additional topics to be discussed may include: the solar wind, planetary magnetic fields, planetary ring processes, and mineralogy.

ASTR 625. Cosmology
3 Credits
Discussion of our current knowledge of the structure of the universe and current research methods. Topics include the distance scale, clustering of galaxies, large-scale structure, metrics, dark matter, and cosmological probes such as distant quasars, radio galaxies, and gravitational lenses.

ASTR 630. Methods of Statistical Analysis for Modern Astronomy
3 Credits
Graduate class for students interested in applying statistical techniques to modern astrophysical data sets. Topics include a review of probability and probability distribution functions, implications of techniques for statistical inference, regression and multivariate analysis, data smoothing, data mining, survival analysis and time domain analysis. Applications to real astronomical data sets will be emphasized with all topics.

ASTR 670. Heliophysics
3 Credits
Explore the Sun and its processes, the heliopshere, and its interactions with the planets. Topics include: A introductory description of space weather and its physics; energy interaction with the space environment; the quiet Sun and its interactions with planetary atmospheres (with an emphasis on Earth); Magnetohydrodynamics; frozen-in flux; the solar wind; magnetized fluid dynamics; the active Sun (flares and coronal mass ejections); the effects of Space Weather.

ASTR 698. Special Topics.
1-9 Credits
Special topics.

ASTR 700. Doctoral Dissertation
15 Credits
Dissertation.

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