ASTRONOMY (ASTRO)

ASTRO 1101 - From New Worlds to Black Holes (3 Credits)
Explore the wonders of the universe, from black holes to newly discovered worlds. This course covers the birth and death of stars, the nature of black holes, and the search for extraterrestrial life. Engage with the latest discoveries and understand how we are made of stardust.
Forbidden Overlaps: ASTRO 1101, ASTRO 1103
Distribution Requirements: (OPHLS-AG), (PHS-AS), (SCT-IL)
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 1102 - Our Solar System (4 Credits)
Study the formation, evolution, and current state of our solar system, including the Sun, planets, moons, asteroids, and comets. Learn from NASA mission data and explore planetary geology, atmospheric science, impact hazards, global warming, and the search for life beyond Earth.
Forbidden Overlaps: ASTRO 1102, ASTRO 1104
Distribution Requirements: (OPHLS-AG), (PHS-AS), (SCT-IL)
Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 1103 - From New Worlds to Black Holes (4 Credits)
Forbidden Overlaps: ASTRO 1101, ASTRO 1103
Distribution Requirements: (SCT-IL)
Last Four Terms Offered: Fall 2021, Fall 2019, Fall 2018, Fall 2017
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 1105 - The Universe (3 Credits)
When civilization was young, Seneca wrote, A single lifetime, even entirely devoted to the sky, would not be enough for the investigation of so vast a subject. Our descendants will be amazed that we did not know things that are so plain to them. We will work to understand what he and the ancients knew about the night sky, and the ingenious methods by which they came to know it, and trace the history of astronomy through the modern day. Indeed, modern astronomy abounds with strange alien worlds and exotic events that would have amazed that great classical thinker. Stars and the tantalizing planets that journey with them through the galaxies, which smash into one another over millions of years. And when they die in great explosions, stars create exotic pulsars, black holes, nebulae, and people. And somehow all of this started at the single moment of the Big Bang. What will be so plain to our descendants that would amaze us today? Will they have contacted alien intelligence? Traveled in time? Learned the fate of the universe?
Forbidden Overlaps: ASTRO 1105, ASTRO 1107
Distribution Requirements: (OPHLS-AG), (PHS-AS), (SCT-IL)
Last Four Terms Offered: Summer 2025, Summer 2024, Summer 2023, Summer 2022
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 1106 - Relativity, Cosmology, and Black Holes (3 Credits)
Explanation of Einstein's theory of Special Relativity, which brought about a fundamental change in our conceptual understanding of space and time. The consequences of the theory: the relativity of simultaneity; mass-energy equivalence, nuclear fission and fusion and thermonuclear processes in starts; why we can't travel faster than the speed of light; and how it all makes sense, including the resolution of some apparent paradoxes. Cosmology, studying the evidence for the evolution and future of the universe, and the considerations and evidence driving our theories, including an introduction to General Relativity and investigation of Dark Matter and Dark Energy. The death of stars: white dwarfs, neutron stars and pulsars, and black holes.
Prerequisites: high school algebra and trigonometry.
Distribution Requirements: (OPHLS-AG), (PHS-AS), (SCT-IL)
Last Four Terms Offered: Summer 2025, Summer 2024, Summer 2023, Summer 2022
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 1107 - The Universe (4 Credits)
When civilization was young, Seneca wrote, A single lifetime, even entirely devoted to the sky, would not be enough for the investigation of so vast a subject. Our descendants will be amazed that we did not know things that are so plain to them. We will work to understand what he and the ancients knew about the night sky, and the ingenious methods by which they came to know it, and trace the history of astronomy through the modern day. Indeed, modern astronomy abounds with strange alien worlds and exotic events that would have amazed that great classical thinker. Stars and the tantalizing planets that journey with them through the galaxies, which smash into one another over millions of years. And when they die in great explosions, stars create exotic pulsars, black holes, nebulae, and people. And somehow all of this started at the single moment of the Big Bang. What will be so plain to our descendants that would amaze us today? Will they have contacted alien intelligence? Traveled in time? Learned the fate of the universe?
Forbidden Overlaps: ASTRO 1105, ASTRO 1107
Distribution Requirements: (OPHLS-AG), (PHS-AS), (SCT-IL)
Last Four Terms Offered: Summer 2025, Summer 2024, Summer 2023, Summer 2022
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 1111 - From New Worlds to Black Holes (3 Credits)
Last Four Terms Offered: Fall 2022
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 1112 - The Solar System and Beyond (3 Credits)
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 1195 - Observational Astronomy (3 Credits)
A hands-on introduction to observational astronomy. Learn how we gather knowledge about the universe using amateur telescopes. Includes evening labs featuring telescope observations at Fuertes Observatory and Mount Pleasant, as well as in-class experiments such as micrometeorite collection.
Distribution Requirements: (OPHLS-AG), (PHS-AS), (SCT-IL)
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2021, Fall 2020
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 1199 - Are We Alone in the Universe? (3 Credits)
This course surveys the possibilities for life in the universe and the search for it, against the backdrop of our modern understanding of the cosmos. It covers ideas about the origin of the universe and how structure arises, the formation of stars and planets, how life might have begun on planets, the evolution of life on the Earth, and the search for life elsewhere in the solar system and beyond.
Prerequisites: high school physics and biology.
Distribution Requirements: (OPHLS-AG), (PHS-AS)
Last Four Terms Offered: Summer 2025, Summer 2022, Summer 2021, Summer 2019
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 2034 - Black Holes: Race and the Cosmos (3 Credits)
Crosslisted with COML 2034
Co-taught by professors in Comparative Literature and Astronomy, this course will introduce students to the fundamentals of astronomy concepts through readings in Black Studies. We will experiment with what it means to engage with astrophysics concepts both inside and outside of the disciplinary framework of astronomy-for example, in genres like film, afrofuturist science fiction, and critical theory. Do astronomy concepts lose coherence outside of their scientific contexts, or do they acquire a different kind of sense? Why are humanities scholars everlastingly drawn toward the stars? In particular, what do artists and theoreticians of color gain from turning toward cosmological reflection? Texts will include works by authors like Octavia Butler and Dionne Brand, theorists like Sylvia Wynter and Denise Ferreira da Silva, and others. Astronomy concepts will include the electromagnetic spectrum, stellar evolution, and general relativity.
Distribution Requirements: (ALC-AS, PHS-AS), (CA-AG, LA-AG, OPHLS-AG)
Last Four Terms Offered: Spring 2023, Spring 2021
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 2201 - The History of the Universe (3 Credits)
This course explores the evolution of the universe since the Big Bang and how our understanding has developed from ancient to modern times. Topics include the changing views of the sky, the formation of black holes, dark matter and dark energy, and the origin, evolution, and fate of the universe. The course provides a nonmathematical introduction to these subjects and addresses uncertainties and unresolved questions in cosmology.
Distribution Requirements: (OPHLS-AG), (PHS-AS), (SCT-IL)
Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 2202 - A Spacecraft Tour of the Solar System: Science, Policy and Exploration (3 Credits)
Explore planetary science through the lens of spacecraft missions. Learn how missions are selected and developed, and engage with guest speakers from NASA, ESA, and policy experts. Topics include space policy, life in the outer solar system, Mars exploration, and the search for extrasolar planets.
Distribution Requirements: (OPHLS-AG), (PHS-AS), (SCT-IL)
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 2211 - Astronomy: Stars, Galaxies, and Cosmology (3 Credits)
Survey the universe from the Big Bang to galaxy formation. Topics include star formation, stellar evolution, black holes, and cosmology, with discussions on quantum physics, relativity, and particle physics. More in-depth than ASTRO 1101.
Prerequisites: introductory calculus or co-registration in MATH 1110 or MATH 1910 or permission of instructor.
Enrollment Information: Primarily for: first- and second-year students with interests in astronomy and astrophysical science, including (but not limited to) engineering and physical sciences students.
Distribution Requirements: (OPHLS-AG), (PHS-AS), (SCT-IL)
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Spring 2022
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 2212 - The Solar System: Planets, Small Bodies and New Worlds (3 Credits)
A quantitative exploration of planetary systems. Topics include orbital dynamics, planetary atmospheres, greenhouse effects, and smaller bodies like asteroids and comets. Includes comparisons to exoplanetary systems. More rigorous than ASTRO 1102.
Prerequisites: introductory calculus or co-registration in MATH 1110 or MATH 1910; some knowledge of classical physics (mechanics and thermodynamics).
Enrollment Information: Primarily for: first- and second-year Physical Science and Engineering students.
Distribution Requirements: (OPHLS-AG), (PHS-AS)
Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Fall 2021
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 2290 - Relativity and Astrophysics (3 Credits)
This course is primarily an introduction to special relatvity with astrophysical applications. Later in the course we will also navigate the space-times around non-rotating and rotating black holes theoretically, with astrophysical applications. If time permits, gravitational radiation and cosmology will also be featured.
Prerequisites: two physical science courses or instructor permission.
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 2299 - Search for Life in the Universe (3 Credits)
Investigate the potential for life beyond Earth, covering cosmic evolution, planetary formation, life's origins, and astrobiology. Includes current efforts in the search for extraterrestrial life.
Prerequisites: two courses in any physical science subject or permission of instructors.
Distribution Requirements: (OPHLS-AG), (PHS-AS)
Last Four Terms Offered: Spring 2024, Spring 2022, Spring 2020, Spring 2018
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 3301 - Exoplanets and Planetary Systems (3 Credits)
More than five thousand planets circling other stars have been discovered over the past two decades, and many more discoveries are sure to come. With the recent launch of the James Webb Space Telescope (Dec 2021) astronomers will be able to probe the atmosphere of potential Earth-like planets for the first time.How are these discoveries made and what are the properties of these exoplanets and their systems? How exotic can exoplanets to be? Would you survive on them? Is our solar system a typical planetary system or something unusual? How common are planets like Earth? How can we determine whether exoplanets can host life, or do host life? These and other issues related to planetary formation and evolution will be discussed in the course.
Prerequisites: PHYS 1112 or PHYS 1116 and PHYS 2213 or PHYS 2217, MATH 1120, MATH 1910 or MATH 1920 or permission of instructor.
Distribution Requirements: (OPHLS-AG), (PHS-AS)
Last Four Terms Offered: Fall 2024, Spring 2023, Fall 2020, Spring 2019
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 3302 - The Life of Stars: From Birth to Death (3 Credits)
Study stellar formation, evolution, and final stages as white dwarfs, neutron stars, or black holes. Covers fundamental astrophysical concepts and observational evidence.
Prerequisites: PHYS 2214 or PHYS 2218, can be enrolled concurrently, and MATH 1120 or MATH 1920.
Distribution Requirements: (OPHLS-AG), (PHS-AS)
Last Four Terms Offered: Spring 2024, Spring 2022, Fall 2019, Spring 2018
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 3303 - Galaxies Across Cosmic Time (3 Credits)
Explore galaxy formation and evolution over 13+ billion years. Topics include the role of black holes, dark matter, mergers, and cosmic environments in shaping galaxies.
Prerequisites: MATH 1120, MATH 1910, or MATH 1920, PHYS 1112, PHYS 1116, or PHYS 2217 or permission of instructor.
Distribution Requirements: (OPHLS-AG), (PHS-AS)
Last Four Terms Offered: Fall 2024, Spring 2024, Fall 2021, Spring 2020
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 3310 - Planetary Image Processing with MATLAB (3 Credits)
Reviews basic techniques employed in the collection and processing of spacecraft images of solar system objects using MATLAB. Experience with MATLAB is not strictly necessary, but some general experience with computer programming is preferred.
Prerequisites: two semesters of introductory physics and some general experience with computer programming.
Enrollment Information: Enrollment priority given to: sophomores or juniors majoring or concentrating in Astronomy or related fields.
Distribution Requirements: (OPHLS-AG), (PHS-AS, SDS-AS)
Last Four Terms Offered: Spring 2025, Spring 2023, Fall 2015, Fall 2009
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 3334 - Data Analysis and Research Techniques in Astronomy (3 Credits)
Introduction to the tools of data processing and analysis for research in astronomy. The course reviews the techniques employed in astrophysical research, both observational and theoretical, to explore the universe. Methods and strategies of data acquisition and image and signal processing are discussed. Students gain hands-on experience with visualization techniques and methods of error analysis, data fitting, numerical simulation, and data scalability. Exercises address the processes by which astrophysicists piece together observations made with today's foremost astronomical instruments to solve questions concerning the origin of planets, stars, galaxies, and the universe itself. This course prepares students with the techniques and computing tools necessary to undertake research in astronomy and other data-driven fields.
Prerequisites: two semesters of introductory physics and two semesters of calculus or permission of instructor.
Distribution Requirements: (OPHLS-AG), (PHS-AS, SDS-AS)
Last Four Terms Offered: Spring 2024, Spring 2022, Spring 2021, Spring 2020
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 3340 - Symbolic and Numerical Computing (4 Credits)
Introduces Mathematica and symbolic computation for applications across sciences and engineering. Includes programming concepts, data analysis, and a final project in an area of interest.
Prerequisites: calculus.
Distribution Requirements: (OPHLS-AG), (SDS-AS, SMR-AS)
Last Four Terms Offered: Fall 2023, Fall 2021, Spring 2020, Fall 2017
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 4410 - Multiwavelength Astronomical Techniques (4 Credits)
Covers observational techniques in optical and radio astronomy. Topics include CCD imaging, spectroscopy, and interferometry. Labs use observatories on campus, emphasizing data analysis and instrumentation.
Prerequisites: PHYS 2214, PHYS 2218, PHYS 3310, or PHYS 3360.
Enrollment Information: Priority given to: Astronomy and Physics majors.
Distribution Requirements: (OPHLS-AG), (PHS-AS, SDS-AS)
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 4431 - Physics of Stars, Neutron Stars and Black Holes (3 Credits)
Covers stellar structure, solar neutrinos, stellar seismology, and the physics of compact objects like white dwarfs, neutron stars, and black holes.
Prerequisites: mathematics above 2000 level, physics above 3000 level.
Enrollment Information: Recommended prerequisite: PHYS 4443.
Distribution Requirements: (OPHLS-AG), (PHS-AS)
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Spring 2022
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 4432 - Astrophysical Processes (3 Credits)
Examines the production, interaction, and detection of electromagnetic radiation, cosmic rays, and gravitational waves to interpret astrophysical phenomena.
Prerequisites: PHYS 1112, 2213, 2214, 2216; MATH 1920 or 2220; MATH 2930 or 3270; PHYS 3316.
Distribution Requirements: (OPHLS-AG), (PHS-AS)
Last Four Terms Offered: Spring 2025, Spring 2023, Spring 2021, Spring 2019
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 4433 - Introduction to Cosmology (3 Credits)
Crosslisted with PHYS 4433
This course provides an introduction to theoretical and observational cosmology for science and engineering majors. Topics include general relativity in cosmology, the history of cosmic expansion, early universe processes, galaxy and cluster formation, and current and upcoming cosmological surveys, such as those of galaxies, galaxy clusters, gravitational lensing, and the cosmic microwave background. The course is designed at a less technical level than the graduate-level course ASTRO 6599.
Prerequisites: math/calculus at 2000-level, physics at 3000-level or permission of instructor.
Distribution Requirements: (CHPH-AG, OPHLS-AG), (PHS-AS)
Last Four Terms Offered: Fall 2023, Fall 2021, Fall 2019, Spring 2017
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 4434 - Physics of the Planets (3 Credits)
Explores planetary physics, including orbital dynamics, tidal interactions, planetary interiors, atmospheres, and radiative transfer.
Prerequisites: PHYS 1112 or PHYS 1116 and PHYS 2218 or PHYS 2210
Distribution Requirements: (OPHLS-AG), (PHS-AS)
Last Four Terms Offered: Spring 2025
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 4445 - Introduction to General Relativity (4 Credits)
Crosslisted with PHYS 4445
One-semester introduction to general relativity that develops the essential structure and phenomenology of the theory without requiring prior exposure to tensor analysis. General relativity is a fundamental cornerstone of physics that underlies several of the most exciting areas of current research, including relativistic astrophysics, cosmology, and the search for a quantum theory of gravity. The course briefly reviews special relativity, introduces basic aspects of differential geometry, including metrics, geodesics, and the Riemann tensor, describes black hole spacetimes and cosmological solutions, and concludes with the Einstein equation and its linearized gravitational wave solutions. At the level of Gravity: An Introduction to Einstein's General Relativity by Hartle.
Prerequisites: classical mechanics at the level of PHYS 3318 and special relativity at the level of PHYS 1116 or PHYS 2216. Electromagnetism at the level of PHYS 3327 is useful.
Distribution Requirements: (CHPH-AG, OPHLS-AG), (PHS-AS, SMR-AS)
Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 4523 - Modeling, Mining and Machine Learning in Astronomy (3 Credits)
This course covers probability, statistics, and signal processing to develop algorithms for detecting objects and events in astronomical data. Topics include frequentist and Bayesian model inference, time-series analysis, clustering, classification, genetic algorithms, Markov Chain Monte Carlo, and neural networks. Students will apply these methods to real and simulated data using Python and Jupiter notebooks.
Prerequisites: background in probability and statistics at the level of ENGRD 2700 or MATH 1710 or equivalent; lower division math background equivalent for a physics or engineering major.
Enrollment Information: Recommended prerequisite: knowledge of Python or MATLAB.
Distribution Requirements: (OPHLS-AG), (PHS-AS, SDS-AS)
Last Four Terms Offered: Spring 2023, Spring 2021, Spring 2019
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 4940 - Independent Study in Astronomy (1-4 Credits)
Allows students to conduct independent research or study a specific area of astronomy under faculty supervision. A written report is required.
Exploratory Studies: (CU-UG)

Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 6509 - General Relativity I (3 Credits)
Crosslisted with PHYS 6553
A comprehensive introduction to Einstein's theory of relativistic gravity. This course focuses on the formal structure of the theory.
Prerequisites: knowledge of special relativity and methods of dynamics at level of Classical Mechanics by Goldstein.
Last Four Terms Offered: Fall 2024, Fall 2022, Fall 2020, Fall 2018
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 6510 - General Relativity II (3 Credits)
Crosslisted with PHYS 6554
A continuation of PHYS 6553 and ASTRO 6509 that covers a variety of advanced topics and applications of general relativity in astrophysics, cosmology, and high-energy physics.
Prerequisites: PHYS 6553 or permission of instructor.
Last Four Terms Offered: Spring 2025, Spring 2023, Spring 2021, Spring 2019
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 6511 - High Energy Astrophysics (3 Credits)
Crosslisted with PHYS 6525
Compact objects (neutron stars, black holes and white dwarfs) are the endpoints of stellar evolution. They are responsible for some of the most exotic phenomena in the universe such as supernovae, magnetars, gamma-ray bursts, neutron star and black hole mergers. Supermassive black holes also lie at the heart of the violent processes in active galactic nuclei. The study of compact objects allows one to probe physics under extreme conditions (high densities, strong magnetic fields, and gravity). This course surveys the astrophysics of compact stars and related subjects. Emphasis is on the application of diverse theoretical physics tools to various observations of compact stars. There are no astronomy or general relativity prerequisites.
Prerequisites: senior level physics at upper-division undergraduate level.
Last Four Terms Offered: Spring 2025, Fall 2022, Spring 2021, Fall 2018
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 6516 - Galactic Structure and Stellar Dynamics (3 Credits)
This course will focus on topics related to the structure and dynamics of collisionless and mildly collisional systems in galaxies: stars in the galactic disk, stars in globular clusters, stars in open clusters, spiral arms, and the galactic center, as well as stars in binary and triple systems. We shall also discuss the formation, structure and evolution of the galaxy and its halo. There are no specific prerequisites for this course, but knowledge of classical mechanics at the level of Physics 3318 or AEP 3330 and practical familiarity with differential equations and linear algebra at the level of MATH 2940 will be assumed. Students should be aware of the existence of the objects mentioned in the course description.
Last Four Terms Offered: Spring 2024, Fall 2021, Fall 2019, Spring 2018
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 6523 - Modeling, Mining and Machine Learning in Astronomy (3 Credits)
This course covers probability, statistics, and signal processing to develop algorithms for detecting objects and events in astronomical data. Topics include frequentist and Bayesian model inference, time-series analysis, clustering, classification, genetic algorithms, Markov Chain Monte Carlo, and neural networks. Students will apply these methods to real and simulated data using Python and Jupiter notebooks.
Prerequisites: background in probability and statistics at the level of ENGRD 2700 or MATH 1710 or equivalent; lower division math background equivalent for a physics or engineering major.
Enrollment Information: Recommended prerequisite: knowledge of Python or MATLAB.
Last Four Terms Offered: Spring 2023, Spring 2021, Spring 2019, Spring 2017
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 6525 - Multiwavelength Astronomical Techniques (3 Credits)
This course covers telescope design, optics design and instrumentation for wavelengths from optical to radio and their relation to current research needs. Adaptive optics, interferometry, aperture synthesis, and beam forming will be covered. Instrumentation discussions will include CCD and IR/submillimeter detector arrays, heterodyne systems and phased array feeds at radio wavelengths as well as camera designs, cryogenic systems, spectrographs/spectrometers and interferometric correlators. Sensitivity issues, observing techniques, polarimetry and data analysis will be discussed. Course work includes observations with the Hartung-Boothroyd optical telescope on Mount Pleasant and a radio telescope on the roof of the Space Sciences Building. Data from these observations will be processed using modern analysis techniques implemented primarily in Python.
Last Four Terms Offered: Fall 2023, Fall 2021, Fall 2019, Fall 2017
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 6530 - Astrophysical Processes (3 Credits)
Astronomers study cosmic phenomena through radiation, including electromagnetic, neutrinos, cosmic rays, and gravitational waves. This course focuses on electromagnetic radiation, exploring its production, interaction, and observation, with brief discussion of other types.
Prerequisites: PHYS 1112, 2213, 2214, 2216; MATH 1920 or 2220; MATH 2930 or 3270; PHYS 3316.
Last Four Terms Offered: Spring 2025, Spring 2024, Fall 2021, Fall 2019
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 6531 - Astrophysical Fluid Dynamics (3 Credits)
This course will survey fluid dynamics (including magnetohydrodynamics and some plasma physics) important for understanding astronomical phenomena. Topics include basic fluid and MHD concepts and equations, waves and instabilities of various types (e.g., sound, gravity, Rossby, hydromagnetic, spiral density waves; Rayleigh-Taylor, thermal, Jeans, rotational, magnetorotational instabilities), shear and viscous flows, turbulence, shocks and blast waves, etc. These topics will be discussed in different astrophysical contexts and applications, such as atmosphere and ocean, star and planet formation, compact objects, interstellar medium, galaxies and clusters.
Enrollment Information: Primarily for: graduate students (both theory and observation) and senior undergraduates in physics and engineering interested in astrophysics and space physics.
Last Four Terms Offered: Fall 2024, Spring 2023, Spring 2021, Fall 2017
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 6560 - Physics of Stars, Neutron Stars and Black Holes (3 Credits)
Crosslisted with PHYS 7667
Covers stellar structure, evolution, and the physics of compact objects, including neutron stars and black holes.
Prerequisites: Math above 2000 level, physics above 3000 level.
Enrollment Information: Recommended prerequisite: PHYS 4443.
Last Four Terms Offered: Fall 2024, Spring 2023, Fall 2020, Spring 2019
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 6570 - Physics of the Planets (3 Credits)
Focuses on planetary dynamics, atmospheres, and interior structure, with applications to solar system and exoplanetary science.
Prerequisites: PHYS 1112 or 1116, PHYS 2218 or 2210 or equivalent.
Enrollment Information: Primarily for: graduate students and seniors in astronomy, physics, engineering and related fields.
Last Four Terms Offered: Spring 2025, Fall 2023, Spring 2022, Spring 2020
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 6575 - Planetary Atmospheres (3 Credits)
Crosslisted with EAS 5750
This course will provide an overview of fundamental physical processes that govern the structure and behavior of atmospheres in the solar system and beyond. Topics covered will include the basic principles of atmospheric statics, radiative transfer, dynamics, cloud physics, and chemistry to understand the diverse range of observable atmospheres. These topics will be explored through review of relevant physical processes and research in solar system and exoplanetary science. This course is geared toward graduate students with a solid background in relevant math and physics coursework.
Prerequisites: PHYS 2214 or PHYS 2218, MATH 2930 or equivalent.
Last Four Terms Offered: Spring 2024, Fall 2016, Fall 2014, Spring 2013
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 6577 - Planetary Surface Processes (3 Credits)
Crosslisted with EAS 5770
This course explores remote sensing techniques for studying solar system surfaces and the geomorphic processes shaping them. Topics include impact cratering, volcanism, tectonism, and erosion, with an emphasis on terrestrial field sites as planetary analogs. Students will also learn about surface morphology, planetary weathering, and fundamental field and remote sensing methods. An optional 1-credit field trip is available (see ASTRO 6580).
Last Four Terms Offered: Spring 2024, Spring 2022, Spring 2020, Spring 2017
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 6578 - Planet Formation and Evolution (3 Credits)
Crosslisted with EAS 5780
Last Four Terms Offered: Spring 2021, Fall 2017, Spring 2016, Spring 2014
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 6579 - Advanced Astrodynamics (3 Credits)
Crosslisted with MAE 6720
A graduate level course in astrodynamics and trajectory design. Course topics include a brief review of the two body problem, impulsive transfers, and perturbations; orbit determination and one-way ranging; algebraic and symplectic mappings and surfaces of section; the circular and elliptical 3-body problem, invariant manifolds and 3-body orbit design; secular and resonant perturbations; finite and continuous thrust modeling and transfer design. The course will emphasize numerical methods and building deep understanding of modern approaches to orbital design problems. Familiarity with basic orbital mechanics (at the level of MAE 4060 or equivalent) and numerical integration of dynamical systems will be assumed.
Prerequisites: advanced undergraduate course in dynamics.
Enrollment Information: Enrollment limited to: graduate students.
Last Four Terms Offered: Fall 2024, Spring 2022, Spring 2020, Spring 2018
Learning Outcomes:

- Students will be able to understand the evolution of orbits of spacecraft and natural bodies in response to various forces.
- Students will be able to simulate and fit natural orbits and spacecraft trajectories using a variety of computational tools.
- Students will be able to understand the inner workings of modern orbit design and analysis tools.
- Students will be able to understand the dynamical behavior of planetary systems.

Schedule of Classes (https://classes.cornell.edu/)

ASTRO 6580 - Planetary Surface Processes Field Trip (1 Credit)
Field trip to accompany ASTRO 6577.
Corequisites: ASTRO 6577, previous enrollment permitted.
Course Fee: Course Fee, TBA. TBA.
Last Four Terms Offered: Spring 2024
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 6590 - Galaxies and the Universe (3 Credits)
This course offers an overview of the fundamental physical processes shaping the large-scale structure of the universe, with an emphasis on galaxy morphology, dynamics, and evolution. Topics include galaxy formation, stellar feedback, the role of supermassive black holes, the influence of dark matter, and the impact of galactic mergers and gas accretion. Through a combination of observational evidence and theoretical frameworks, we will explore the development of galaxies across cosmic time, integrating key insights from both astrophysical and cosmological perspectives.
Last Four Terms Offered: Spring 2025, Fall 2020, Fall 2014, Fall 2010
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 6599 - Cosmology (3 Credits)
Crosslisted with PHYS 6599
This course explores modern cosmology, covering the Big Bang theory, the universe's matter content, and its evolution. Topics include the early universe, symmetry breaking, inflation, nucleosynthesis, recombination, structure formation, galaxy clustering, and dark energy. Students will also examine current and future observational techniques in cosmology.
Prerequisites: statistical physics, quantum mechanics, and electromagnetic theory courses.
Last Four Terms Offered: Fall 2024, Fall 2022, Fall 2020, Fall 2018
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 6940 - Advanced Study and Research (1-4 Credits)
Guided reading and seminars on topics not currently covered in regular courses.
Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 7340 - Symbolic and Numerical Computing (4 Credits)
Introduces symbolic and numerical computing using Mathematica for scientific and engineering applications. Includes programming, data visualization, and a final project.
Last Four Terms Offered: Fall 2023, Fall 2021, Spring 2020, Fall 2017
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 7600 - First Year Graduate Advising Seminar (1 Credit)
Last Four Terms Offered: Fall 2024
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 7620 - Seminar: Advanced Radio Astronomy (2 Credits)
Last Four Terms Offered: Spring 2022, Spring 2017, Fall 2016, Spring 2010
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 7672 - Seminar: Planetary Science (3 Credits)
Last Four Terms Offered: Fall 2023, Fall 2022
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 7683 - Seminar: Astronomy and Planetary Science (1 Credit)
A reading seminar for graduate students to broaden their astronomy knowledge, practice public speaking, and analyze key findings from seminal research papers.
Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023
Schedule of Classes (https://classes.cornell.edu/)

ASTRO 7690 - Computational Physics (3 Credits)
Crosslisted with PHYS 7680
Develops tools for using computers to model the physical world. Uses examples pulled broadly from core areas of physics: Mechanics, Electricity and Magnetism, Statistical Mechanics and Thermodynamics, and Quantum Mechanics. Focus is on algorithmic thinking, converting mathematical representations into practical algorithms, working with data, and drawing physical conclusions from numerical results. Model problems will involve numerical quadratures, ordinary and partial differential equations, numerical linear algebra, event based simulations, and Monte Carlo techniques. May include modern techniques, such as those drawn from machine learning and artificial intelligence. Instruction will largely be in Julia, with computer labs integrated into lectures. No prior experience with Julia is necessary, but students should have some experience with programming. Graduate versions, PHYS 7680 and ASTRO 7690, require an additional project which is not required in the undergraduate version, PHYS 4480.
Enrollment Information: Requires familiarity with core undergraduate curriculum, and some experience with programming.
Last Four Terms Offered: Fall 2024, Fall 2022, Fall 2020, Fall 2019
Schedule of Classes (https://classes.cornell.edu/)