ASTRONOMY (ASTR)

* ASTR 040a / PHYS 040a, Expanding Ideas of Time and Space  Meg Urry
Discussions on astronomy, and the nature of time and space. Topics include the shape and contents of the universe, special and general relativity, dark and light matter, and dark energy. Observations and ideas fundamental to astronomers' current model of an expanding and accelerating four-dimensional universe. Enrollment limited to first-year students. Preregistration required; see under First-Year Seminar Program.  SC

ASTR 110a, Planets and Stars  Michael Faison
Astronomy introduction to stars and planetary systems. Topics include the solar system and extrasolar planets, planet and stellar formation, and the evolution of stars from birth to death. No prerequisite other than a working knowledge of elementary algebra.  QR, SC

ASTR 120b, Galaxies and the Universe  Jeffrey Kenney
An introduction to stars and stellar evolution; the structure and evolution of the Milky Way galaxy and other galaxies; quasars, active galactic nuclei, and supermassive black holes; cosmology and the expanding universe. No prerequisite other than a working knowledge of elementary algebra.  QR, SC

ASTR 130b, Origins and the Search for Life in the Universe  Michael Faison
Origins of the universe, stars, and planets; evolution of conditions that were conducive to the emergence of life on Earth; leading theories for the origin of life; the discovery of exoplanets; comparison of Earth's solar system with other systems that have been discovered; the possibility of habitable conditions where life might have arisen on other worlds; methods of searching for life elsewhere. No prerequisite other than a working knowledge of elementary algebra.  SC

ASTR 155a, Introduction to Astronomical Observing  Michael Faison
A hands-on introduction to techniques used in astronomy to observe astronomical objects. Observations of planets, stars, and galaxies using on-campus facilities and remote observing with Yale's research telescopes. Use of electronic detectors and computer-aided data processing. Evening laboratory hours required. One previous college-level science laboratory or astronomy course recommended.  SC  ½ Course cr

ASTR 160a, Frontiers and Controversies in Astrophysics  Marla Geha
A detailed study of three fundamental areas in astrophysics that are currently subjects of intense research and debate: planetary systems around stars other than the sun; pulsars, black holes, and the relativistic effects associated with them; and the age and ultimate fate of the universe. No prerequisite other than a working knowledge of elementary algebra.  QR, SC

ASTR 210b, Stars and Their Evolution  Robert Zinn
Foundations of astronomy and astrophysics, focusing on an intensive introduction to stars. Nuclear processes and element production, stellar evolution, stellar deaths and supernova explosions, and stellar remnants including white dwarfs, neutron stars, and black holes. A close look at our nearest star, the sun. How extrasolar planets are studied; the results of such studies. Prerequisite: a strong background in high school calculus and physics. May not be taken after ASTR 220.  QR, SC
ASTR 255a / PHYS 295a, Research Methods in Astrophysics  Hector Arce
An introduction to research methods in astronomy and astrophysics. The acquisition and analysis of astrophysical data, including the design and use of ground- and space-based telescopes, computational manipulation of digitized images and spectra, and confrontation of data with theoretical models. Examples taken from current research at Yale and elsewhere. Use of the Python programming language. Prerequisite: background in high school calculus and physics. No previous programming experience required. QR, SC RP

ASTR 310a, Galactic and Extragalactic Astronomy  Jeffrey Kenney
Structure of the Milky Way galaxy and other galaxies; stellar populations and star clusters in galaxies; gas and star formation in galaxies; the evolution of galaxies; galaxies and their large-scale environment; galaxy mergers and interactions; supermassive black holes and active galactic nuclei. Prerequisites: MATH 115, PHYS 201, and ASTR 210 or 220, or equivalents, or with permission of instructor. QR, SC

ASTR 320b, Physical Processes in Astronomy  Frank van den Bosch
Introduction to the physics required for understanding current astronomical problems. Topics include basic equations of stellar structure, stellar and cosmic nucleosynthesis, radiative transfer, gas dynamics, and stellar dynamics. Numerical methods for solving these equations. Prerequisites: MATH 120 and PHYS 201 or equivalents, or permission of instructor. Previous experience with computer programming recommended. Taught in alternate years. QR, SC

ASTR 330b, Scientific Computing in Astrophysics  Marla Geha
Scientific computer programming in Astrophysics with a focus on the Python Programming language. Algorithms and workflows for reducing and analyzing Astrophysical datasets, both observational and computational. Emphasis is placed on best coding practices, including readability, version control, documentation, and computational efficiency. Weekly lectures, in-depth tutorial/workshops, and invited outside expert guest speakers. Students complete a programming project based on real astrophysical datasets. Prerequisite: ASTR 255 or permission of instructor. Some basic programming experience in Python is strongly recommended.

ASTR 343a / PHYS 343a, Gravity, Astrophysics, and Cosmology  Daisuke Nagai
Introduction to frontier areas of research in astrophysics and cosmology exploring ideas and methods. In-depth discussion of the physics underlying several recent discoveries including extrasolar planets—their discovery, properties, and issues of habitability; black holes—prediction of their properties from GR, observational signatures, and detection; and the accelerating universe—introduction to cosmological models and the discovery of dark energy. Prerequisites: PHYS 170, 171, or 180, 181, or 200, 201, or 260, 261, or permission of instructor. QR, SC

ASTR 420a, Computational Methods for Astrophysics  Paolo Coppi
The analytic, numerical, and computational tools necessary for effective research in astrophysics and related disciplines. Topics include numerical solutions to differential equations, spectral methods, and Monte Carlo simulations. Applications to common astrophysical problems including fluids and N-body simulations. Prerequisites: ASTR 320, MATH 120, 222 or 225, and 246. QR RP
**ASTR 465a, The Evolving Universe**  Pieter van Dokkum
Overview of cosmic history from the formation of the first star to the present day, focusing on direct observations of the high-redshift universe. Prerequisites: MATH 120, PHYS 201, and one astronomy course numbered above 200. Taught in alternate years.

* ASTR 471a, Independent Project in Astronomy  Marla Geha
Independent project supervised by a member of the department with whom the student meets regularly. The project must be approved by the instructor and by the director of undergraduate studies; the student is required to submit a complete written report on the project at the end of the term.

* ASTR 490a, The Two-Term Senior Project  Marla Geha
A two-term independent research project to fulfill the senior requirement for the B.S. degree. The project must be supervised by a member of the department and approved by the director of undergraduate studies.

* ASTR 492a, The One-Term Senior Project  Marla Geha
A one-term independent research project or essay to fulfill the senior requirement for the B.A. degree. The project must be supervised by a member of the department and approved by the director of undergraduate studies.