

ASTRONOMY (ASTRON)

ASTRON 101-0 Modern Cosmology (1 Unit) Modern views on the structure of the universe, its past, present, and future. For nonscience majors who want to take a more detailed course after completing ASTRON 120-0. *Natural Sciences Distro Area Natural Sciences Foundational Discipline*

ASTRON 102-0 Milky Way Galaxy (1 Unit) Structure of the galaxy, star formation, interstellar clouds and dust, star clusters, neutron stars and black holes, the galactic center. For nonscience majors who want to take a more detailed course after completing ASTRON 120-0. *Natural Sciences Distro Area Natural Sciences Foundational Discipline*

ASTRON 103-0 Solar System (1 Unit) The planets and their moons, the sun, comets, asteroids. For nonscience majors who want to take a more detailed course after completing ASTRON 120-0. *Natural Sciences Distro Area Natural Sciences Foundational Discipline*

ASTRON 105-7 College Seminar (1 Unit) Small, writing and discussion-oriented course exploring a specific topic or theme, and introducing skills necessary to thriving at Northwestern. Not eligible to be applied towards a WCAS major or minor except where specifically indicated.

ASTRON 105-8 First-Year Writing Seminar (1 Unit) Small, writing and discussion-oriented course exploring a specific topic or theme, and focused on the fundamentals of effective, college-level written communication. Not eligible to be applied towards a WCAS major or minor except where specifically indicated.

ASTRON 106-0 A Brief Journey Through the Invisible Universe (1 Unit) A conceptual course exploring the invisible radio universe. Topics include: the historical development of the radio sky, how radio telescopes are fundamentally different than optical telescopes, numerous discoveries with multiple Nobel Prizes over the last century (pulsars, quasars, the Big Bang cosmic microwave background radiation, organic molecules, shadows of supermassive black holes) and search for radio signals from alien civilizations. *Natural Sciences Distro Area Natural Sciences Foundational Discipline*

ASTRON 111-0 Introduction to Astrobiology (1 Unit) The modern scientific perspective on the question of life elsewhere in the universe. The prospects for life on Mars. The discovery of extrasolar planets and the search for extrasolar biospheres. *Natural Sciences Distro Area Natural Sciences Foundational Discipline*

ASTRON 120-0 Highlights of Astronomy (1 Unit) Acquaints students with modern ideas about the solar system, stars, galaxies, and the universe. Emphasizes fundamental principles and underlying concepts. *Natural Sciences Distro Area Natural Sciences Foundational Discipline*

ASTRON 220-1 Introduction to Astrophysics I: Life Cycle of Stars and Planets (1 Unit) The course will explore the origin and evolution of star/planet systems, focusing on underlying physical processes and observational techniques. We will discuss the recent discovery of thousands of planets orbiting stars other than our Sun - a.k.a. "exoplanets". We will also discuss stellar remnant black holes. (Prerequisites: PHYSICS 135-1, PHYSICS 135-2 (concurrent registration in PHYSICS 135-2 is acceptable). *Natural Sciences Distro Area*

ASTRON 220-2 Introduction to Astrophysics II: Galactic Evolution and Cosmology (1 Unit) The course will explore modern cosmology, including dark matter, the Big Bang, curved space-time, the origin and evolution of the first stars and galaxies, cosmic acceleration, and dark energy. In all cases, the focus will be on the underlying physical processes and the observational techniques used. (Prerequisites:

ASTRON 220-1 or all of PHYSICS 135-1, PHYSICS 135-2, and PHYSICS 135-3.) *Natural Sciences Distro Area*

ASTRON 305-0 Basics of Radio Astronomy (1 Unit) Radio astronomy is the study of natural radio emission from the sky, providing important clues about the history of the universe. Topics include how a radio telescope receives invisible signals, how dramatically the radio sky differs from the optical sky, and interferometry. Prerequisites: PHYSICS 135-1, PHYSICS 135-2, PHYSICS 135-3 (or equivalent) or PHYSICS 332-0; MATH 220-2 or equivalent. *Natural Sciences Distro Area*

ASTRON 314-0 Planetary Astrophysics (1 Unit) Methods of exoplanet detection. The observed architecture of exoplanetary systems. Formation and evolution of planetary systems. Modeling exoplanet interiors and atmospheres. Exoplanet habitability and the search for bio-signatures. Prerequisites: PHYSICS 330-1 and PHYSICS 330-2, or equivalent.

ASTRON 321-0 Observational Astrophysics (1 Unit) Geometric optics applied to design of optical and x-ray telescopes; diffraction and the Airy disk; radio and optical interferometry and aperture synthesis; adaptive optics; recent developments in detector technology; quantum and thermal noise in astronomy. Independent research projects using the CCD camera and 18-inch refractor in Dearborn Observatory. Prerequisite: ASTRON 220-1 or ASTRON 220-2. *Advanced Expression*

ASTRON 325-0 Stellar Astrophysics (1 Unit) Physics of stellar interiors, stellar atmospheres, and star formation. Specific topics include simple stellar models, nuclear energy generation, overview of evolutionary phases, white dwarfs, neutron stars, interstellar gas and dust grains, gravitational collapse. Prerequisite: ASTRON 220-1 or ASTRON 220-2.

ASTRON 329-0 Extragalactic Astrophysics and Cosmology (1 Unit) Big bang cosmology, thermal history of the universe, primordial nucleosynthesis, microwave background, dark matter, largescale structure, galaxy formation, spiral and elliptical galaxies, groups and clusters of galaxies. Prerequisite: ASTRON 220-1 or ASTRON 220-2.

ASTRON 331-0 Astrophysics for ISP (1 Unit) Stellar structure and evolution: nucleosynthesis, supernova phenomena, white dwarfs, neutron stars, and black holes. Limited to students enrolled in ISP or with consent of the physics department. Prerequisites: PHYSICS 135-1, PHYSICS 135-2, & PHYSICS 135-3, or equivalent.

ASTRON 390-0 Current Topics in Astronomy (1 Unit) Explores in detail an area of current research interest in astrophysics. Contact the department or instructor for specifics. May be repeated for credit with change of topic. Prerequisites vary. *Natural Sciences Distro Area*

ASTRON 398-0 Honors Independent Study (1-2 Units)

ASTRON 399-0 Independent Study (1-2 Units) Opportunity to study an advanced subject under the individual direction of a faculty member. Open to all advanced students. Consent of instructor required.